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On the knowledge of *Bembecia rushana* Gorbunov, 1992 and some related species (Lepidoptera: Sesiidae)

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Subject Editor: Jadranka Rota.

Abstract. During several expeditions in Tajikistan (Central Asia) numerous specimens of a species of *Bembecia* Hübner, 1819 were collected which were initially identified as *B. karategina* Špatenka, 1997. On subsequent comparison with the type specimens of several Central Asiatic species, these specimens proved conspecific with *Bembecia rushana* Gorbunov, 1992, which was also described from Tajikistan. Therefore, based on morphological characteristics, genitalia morphology, DNA analysis and rearing results, *B. karategina* is considered here to be a subjective junior synonym of *Bembecia rushana*. In addition to the typical yellow specimens, black specimens of both sexes have also been found and are described here for the first time. During the examination of the type specimens it became clear that the female paratype ("allotype") of *B. karategina* was misidentified. It belongs to *Bembecia hissorensis* Stalling, Bartsch, Garrevoet, Lingenhöle & Altermatt, 2011 and is hitherto the only known female specimen of this species. Records of *B. rushana* from Afghanistan refer to *Bembecia salangica* Špatenka & Reshöft, 1989.

Zusammenfassung. Während verschiedener Expeditionen in Tadschikistan (Zentralasien) konnten zahlreiche Exemplare einer Art von *Bembecia* Hübner, 1819 gesammelt werden, die zunächst als *B. karategina* Špatenka, 1997 bestimmt wurde. Ein späterer Vergleich dieser Tiere mit den Typusexemplaren verschiedener zentralasiatischer Arten der Gattung erwies deren Artgleichheit mit *B. rushana* Gorbunov, 1992, die ebenfalls aus Tadschikistan beschrieben wurde. Basierend auf äußeren Merkmalen, der Genitalmorphologie und der DNA-Analyse sowie den Zuchtergebnissen wird *B. karategina* hier als subjektives jüngeres Synonym von *B. rushana* angesehen. Neben typischen gelben, konnten auch schwarze Exemplare beiderlei Geschlechts gefunden werden, die hier erstmals beschrieben werden. Bei der Untersuchung der Typusexemplare zeigte sich weiterhin, dass der weibliche Paratypus ("Allotypus") von *B. karategina* fehlbestimmt wurde. Er gehört *Bembecia hissorensis* Stalling, Bartsch, Garrevoet, Lingenhöle & Altermatt, 2011 an und stellt das einzige bisher bekannt gewordene Weibchen dieser Art dar. Meldungen von *B. rushana* aus Afghanistan betreffen *B. salangica* Špatenka & Reshöft, 1989.

Résumé. Au cours de plusieurs expéditions en Asie centrale (Tadjikistan) un grand nombre d'exemplaires d'une espèce de *Bembecia* Hübner, 1819 a été recueilli. Ils ont d'abord été identifiés comme *B. karategina* Špatenka, 1997. Ensuite, la comparaison avec les spécimens types de plusieurs espèces de l'Asie centrale a prouvé que ces exemplaires sont conspécifiques avec *Bembecia rushana* Gorbunov, 1992, également décrit du Tadjikistan. Par conséquent, basé sur des caractéristiques externes, la morphologie génitale, les analyses d'ADN et les résultats d'élevage, *B. karategina* est considéré ici comme synonyme subjectif junior de *Bembecia rushana*. A côté des exemplaires typiquement jaunes aussi des spécimens noirs des deux sexes ont été trouvés qui sont décrits ici pour la première fois. Pendant l'examen des spécimens types, il est devenu clair que la femelle paratype ("allotype") de *B. karategina* a été mal identifiée. Elle appartient à *Bembecia hissorensis* Stalling, Bartsch, Garrevoet, Lingenhöle & Altermatt, 2011 et représente jusqu'ici le seul spécimen femelle connu de cette espèce. Les données de *B. rushana* de l'Afghanistan appartiennent à *Bembecia salangica* Špatenka & Reshöft, 1989.

Introduction

The apparently monophyletic genus *Bembecia* Hübner, 1819, with 103 described species, is one of the largest genera of the clearwing moth family. It has its centre of distribution in the south-western part of the Palaearctic region with hot spots in the Mediterranean area and in Central Asia. All species of the genus have a reduced, non-functional proboscis and their larvae develop over one or two years in the roots or lower parts of the stems of various species of Fabaceae.

In multiple expeditions to the Hissar-Alai in Tajikistan, the authors captured extensive series of several *Bembecia* species. The majority were males, which were attracted by various synthetic pheromones, but females and early stages of many species were also found. Some of them proved to be new to science and have since been described (Garrevoet & Garrevoet 2011; Garrevoet & Lingenhöle 2011; Lingenhöle & Bartsch 2011; Stalling et al. 2010, 2011). The commonest species in many places was initially determined as *B. karategina* Špatenka, 1997, according to the "Handbook of Palaearctic Macrolepidoptera" (Špatenka et al. 1999). This species was originally described from a male – which is the holotype – and a female specimen from the southern Hissar-Alai, which were denoted as "found in copula". Nevertheless, they are so different in appearance that the presumption arose that they must belong to different species. During subsequent research to solve this problem the authors came across another *Bembecia* species, also described from Tajikistan, *Bembecia rushana* Gorbunov, 1992. This species was also described from two specimens, a male and a female. Some confusion exists regarding its types, because two descriptions with conflicting type designation have appeared in the literature. In "Entomologicheskoe Obozrenie" (Gorbunov 1992a), which was "approved for printing" on 14 April 1992 and received in the library of ZIN on 29 July 1992 indicating an intermediate publication date, the female is designated as the holotype. In the other paper, published in "May 1992" in "Atalanta" and received in the library of SMNS on the 11th of June 1992, the male is selected (Gorbunov 1992b). A search through the archive of "Entomologicheskoe Obozrenie" did not provide any clarification on the exact publication date (Sinev pers. com.). At present we follow Špatenka et al. (1999) and consider the description in "Entomologicheskoe Obozrenie" as valid, making the female the holotype. Unfortunately, the labelling of the specimens follows the publication in "Atalanta", in contrast to that of the genitalia slides.

The aim of this paper is to clarify the taxonomic status of *B. karategina* and *B. rushana* and to provide short notes on *B. hissorensis* Stalling, Bartsch, Garrevoet, Lingenhöle & Altermatt, 2011 and *B. salangica* Špatenka & Reshöft, 1989.

Materials and Methods

Most of the male specimens were collected using a synthetic pheromone originating from PRI (Plant Research International, Wageningen, The Netherlands) which contains (Z,Z)-3,13-Octadecadienyl acetate and (E,Z)-3,13-Octadecadienyl acetate in a 1:9 ratio. A few specimens were attracted to an old pheromone, with an unknown compo-

sition, for *Synanthedon myopaeformis* (Borkhausen, 1789) from the company BASF (Germany). Some individuals, including several females, were netted without the use of pheromones. A number of specimens of both sexes were also reared from larvae or pupae. Infested plants had to be dug out from the hard and stony soil very carefully. During the expedition, roots with larvae and pupae were kept in small containers. Once home they were placed indoors in terrariums containing a fine moderately moistened 5–7 mm grain hydroculture granulate and sprayed daily to maintain a sufficiently high humidity but avoiding the growth of mould. Most of the type specimens were examined and photographically documented. Preparations of genitalia of several specimens were made using the standard techniques: maceration of the abdomen in 10% KOH, removal of the scales and cleaning in 70% ethanol. Genitalia of males were not stained, and those of females were stained with Chlorazol Black, then embedded in Euparal on a cavity slide, males with opened valvae. DNA was extracted from a midleg of set specimens. DNA analysis ("Barcode" = 658 base pair sequences of mitochondrial COX1 gene) of several Tajik and Afghan *Bembecia* specimens including the types of *B. karategina* was carried out. The PCR primers used were LepF1 and LepR1; the distance model was Kimura 2 Parameter. For details see the "Barcode of Life Database" (BOLD) web page (http://www.barcodinglife.com/views/login.php). The detailed data can be accessed with a login under the project "Global Sesiidae – Clearwing Moths of the World".

Abbreviations

ZMKU	Zoology Museum Kiev University, Ukraine
MWM	Museum Witt München
USPU	Ulyanovsk State Pedagogical University
ZIN	Zoological Institute St. Petersburg, Russia
CTG	collection of T. & W. Garrevoet
CDB	collection of D. Bartsch
CAL	collection of A. Lingenhöle

Results

In addition to the yellow specimens of *B. rushana* found in all localities where the species was recorded, a further expedition to the Peter the First Range at the north-western part of the Pamir Mountains resulted in the discovery of a population with predominantly normal yellow-coloured and occasionally almost black males. DNA analysis showed only small divergences between this population and those of the Hissar-Alai (2.9 %) and no significant morphological differences have been found. Towards the end of this trip an undetermined *Astragalus* L. (Fabaceae) plant, containing fully developed Sesiidae pupae, was found on the southern slopes of the Anzob Pass north of Dushanbe. Shortly afterwards a few specimens of both sexes emerged, including black and normal yellow-coloured females. The striking similarity of the external morphological characteristics of the males, including the types of *B. rushana* and *B. karategina*, the reared

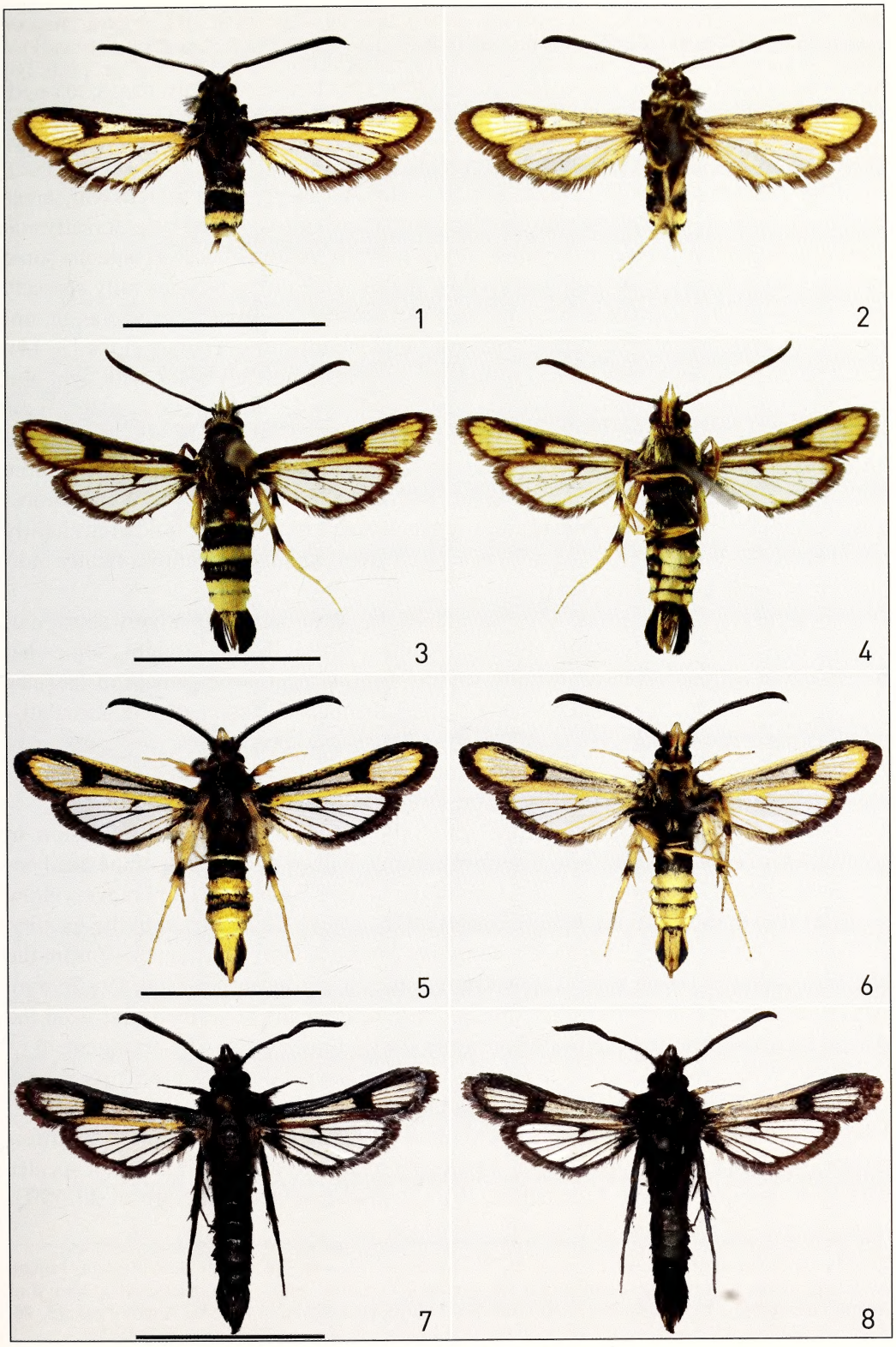
yellow females and the female paratype of *B. rushana*, together with the structure of the genitalia of both sexes and the unambiguous results of the DNA barcode analysis (Fig. A1) led to the conclusion that *B. rushana* and *B. karategina* are conspecific. Hence, *Bembecia karategina* becomes a subjective junior synonym of *B. rushana*. The appearance of the yellow females is also very different from that of the female paratype of *B. karategina*. Therefore, the doubt about the correct identity of the latter specimen proved to be justified. Furthermore, both sexes of the reared specimens agree well with the original figures of *B. rushana* from the south-western Pamir Mountains, but the females differ significantly from the Afghan specimen representing *B. rushana* in the "Handbook of Palaearctic Macrolepidoptera" (Špatenka et al. 1999) and cited by Bartsch & Špatenka (2010). The external appearance as well as the DNA barcode of the female paratype of *B. karategina* support the already existing presumption it belongs to *B. hissorensis*. The Afghan specimens from the Anjuman Pass, Hindu Kush Mountains, Afghanistan, which are mentioned and illustrated as *B. rushana* in the "Handbook of Palaearctic Macrolepidoptera" (Špatenka et al. 1999), belong to *B. salangica*. This conclusion is also supported both by the DNA results and the external morphology of the imagines. The hitherto unknown black forms of both sexes of *B. karategina* are described below.

Bembecia rushana Gorbunov, 1992 — Figs 1–14, 22–29

Bembecia rushana Gorbunov, 1992a: 132. Type locality: Tajikistan, Pamir Os., Rushan, Jugum, Jazgulem, fauces fl. Rav-dara, 3300–3400 m. Holotype: female (ZMKU).
Bembecia karategina Špatenka, 1997: 33 **syn. n.** Type locality: Tajikistan, Karategin range, Romit valley, N 38.40°, E 69.10°, 1500 m. Holotype: male (MWM).

Material. Holotype ♀ (Figs 9, 10, 28), 'Rushan (Pamir oc.) | Jugum Jazgulem | fauces fl. Rav-dara | 3300–3400 m alt., 29 VII 1937 | L. Sheljuzhko et N. Pavlitzkaja leg. | Mus Zool Univers Kijev.', 'rushana Shel, | (holotyp.) | ♀ L. Sheljuzhko det', 'genitalia examinated | by O. Gorbunov | preparation No 0058', 'Paratypus ♀ | Bembecia | rushana Gorbunov | det. O. Gorbunov 1990', ZMUK. – Paratype 1♂ (Figs 1, 2, 22), same label data, 'rushana Shel. | (allotyp.) | ♂ L. Sheljuzhko det', 'genitalia examinated | by O. Gorbunov | preparation No 0059', 'Holotypus ♂ | Bembecia | rushana Gorbunov | det. O. Gorbunov 1990', ZMUK. ♂ holotype of Bembecia karategina Špatenka, 1997 (Figs 3, 4, 23), 'USSR Tadzhikistan | Karategin Ridge | Romit Vall. 1500 m | 69°10′ E 38°40′ N | 12. July 1981 | leg. J. A. Vaněk', 'Holotypus | Bembecia | karategina ♂ | K. Špatenka des.', 'Museum Witt | München', genitalia examined by A. Lingenhöle, Museum Witt prep. 17291, MWM. – **Tajikistan**: Hissar-Alai: Khoja Ob-i Garm, 2350 m, N 38°53′19.9″, E 68°45′08.9″: 22♂ 18.vii.2009; 31♂ 1♀ 26.vii.2010; 136♂ 08.viii.2010 (Garrevoet prep. TG 2011-011, TG 2011-012) (Figs 25, 27) (CTG); 1♂ 18.vii.2010; 6♂ 29.vii.2010; 126♂ 2.viii.2010 (Bartsch prep. 2011-14) (Fig. 24) (CDB); 5♂ 18.vii.2009; 103♂ 2.viii.2011 (Lingenhöle prep. AL 257) (Fig. 26) (CAL); 2 km S of Anzob Pass, 2500 m, N 39°04′13.6″, E 68°51′00.1″: 1♂ 25.vii.2009; 7♂ 29.vii.2010; 61♂ 1♀ 23.vii.2011, 2♂ ex pupa 23.vii.2011, imagines emerged 30.vii.2011 and 4.viii.2011; 6♂ 26.vii.2011; 4♂ (Figs 5, 6), 4♀ (Figs 13, 14), ex larva, 08.vii.2012, males emerged 2x 29.vii.2012, 30.vii.2012 and 10.viii.2012, females 02.viii.2012, 03.viii.2012 and 2x 05.viii.2012 (CTG); 5♂ 23.vii.2011, 2500–2700 m; 1♂ 3♀ (Figs 11, 12), ex pupa, 23.vii.2011, 2500 m, imagines emerged 04.viii.2012, 05.viii.2012, 21.viii.2012, 01.ix.2012; 7♂ 1♀ (Bartsch prep. 2013-01) (Fig. 29) 24.vii.2011,

Figs 1–8. Males of *Bembecia rushana*, scale bars 10 mm (all specimens except for the types in CTG). **1, 2.** Paratype, Pamir, Rushan, Jugum, Jazgulem, fauces fl. Rav-dara (ZMKU). **3, 4.** Holotype of *Bembecia karategina*, Karategin range, Romit valley (MWM). **5, 6.** Yellow form, Hissar-Alai, 2 km S of Anzob Pass. **7, 8.** Black form, Peter the First Range, 50 km NE of Tavildara, Alisurkhon.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2850–3050 m; 1♂ 25.vii.2011, 3020 m (CDB); 36♂ 1♀ 25.vii.2011; 3♂ 25.vii.2011, ex larva, imagines emerged 07.ix.2011 (CAL); Pichev, 1950 m, N 39°02′25.9″, E 69°23′02.2″, 1♂ 21.vii.2009. Peter the First Range: 50 km NE of Tavildara, Alisurkhon, 1950 m, N 38°53′56.2″ E 70°58′01.9″, 19♂ (Figs 7, 8) (CTG) 3♂ (CDB) 14.vii.2011; Gowd, 1950 m, N 38°50′54.3″ E 70°57′53.1″, 36♂ 14.vii.2011 (CAL); 20 km NE of Tavildara, Sabzikharf, 1850 m, N 38°47′46.5″, E 70°40′33.8″, 1♂ 18.vii.2011 (CTG).

Description of the black form of *Bembecia rushana*. Adults. Male (Figs 7, 8). Similar to the yellow form, in size as well as in size and shape of transparent wing areas and discal spots. Body almost entirely black with bluish gloss. Labial palp dorsally and ventro-mesally more or less pale yellow; frons laterally yellow, at base of antenna some yellow scales; vertex with long grey-yellow scales. Anal tuft ventro-laterally sparsely orange-yellow. Forewing anal area and veins of external transparent area orange; underside of both wings with costal area and veins pale yellow. Female (Figs 13, 14). Larger than male, wingspan 22–27 mm. Body almost completely black with light bluish tinge. Labial palp dorsally yellow, ventrally and mesally some yellow scales; frons orange-yellow, medially dark grey; vertex and pericephalic scales orange-yellow, the latter ventrally pale yellow; foretibia and -tarsus ventrally yellow; anal tuft with some yellow scales ventrally; forewing underside with costal area pale yellow. Wings almost opaque; anterior transparent area of forewing and medio-basal part of hindwing slightly translucent, the former always visible as a very narrow slit and sometimes faintly indicated with some dark orange scales.

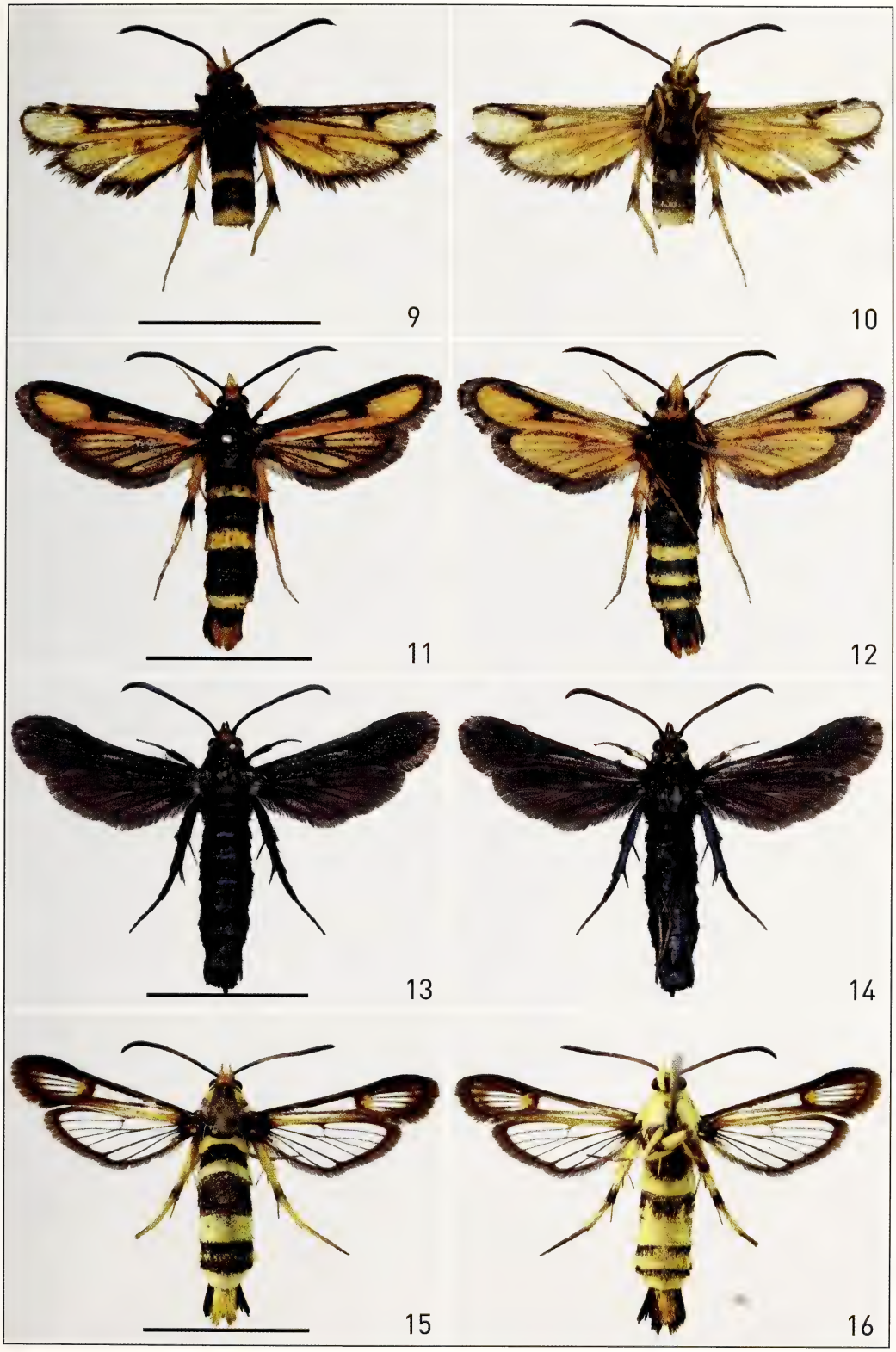
Male genitalia (Figs 22–27). Gnathos with lateral cristae relatively short, medial crista absent. Valva ovoid, apically rounded; crista sacculi straight, somewhat oblique, half as long as valva, distally slightly ventrad bent, arrangement of its setae very variable, often interrupted by a more or less distinct subdistal gap (Fig. 25 subdistal gap only on one side).

Female genitalia (Figs 28, 29). Antrum long and slender, ostium bursae minutely convex.

Variability. Yellow-coloured specimens vary little in colour intensity and extension. In older specimens of the dark form, the bright orange-yellow colouration of the head becomes bleached pale whitish yellow. One of the yellow females has an orange-yellow scapular spot at the forewing base. Differences in size are often related to the locality. Males from Khoja Ob-i Garm have a wingspan of 15–23 mm, whereas those from the southern ascent to Anzob Pass, which is only some 20 km distant, measure 19–26 mm. Also a dependence on different host plants may exist, as the confirmed host from the Anzob Pass was not observed in Khoja Ob-i Garm. In the males, the arrangement of the setae on the crista sacculi is unusually variable: the subdistal gap sometimes even varies within the genitalia of the same specimen (Fig. 25).

Diagnosis. *Bembecia rushana* belongs to the *B. ichneumoniformis* (Denis & Schiffermüller, 1775) species group and may be closely related to other central Asian species such as *B. afghana* Bartsch & Špatenka, 2010, *B. guesnoni* Špatenka & Toševski, 1993,

Figs 9–16. Females of *Bembecia* species. **9, 10.** *Bembecia rushana*, holotype, Pamir, Rushan, Jugum, Jazgulem, fauces fl. Rav-dara (ZMKU). **11, 12.** *Bembecia rushana*, yellow form, Hissar-Alai, 2 km S of Anzob Pass (CDB). **13, 14.** *Bembecia rushana*, black form, Hissar-Alai, 2 km S of Anzob Pass. **15, 16.** *Bembecia hissorensis*, paratype of *Bembecia karategina*, Karategin range, Romit valley (MWM).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B. lamai Kallies, 1996 and *B. zebo* Špatenka & Gorbunov, 1987, all of which lack a medial crista of the gnathos and have the crista sacculi of the valva straight and its setae with subdistal gap. *B. rushana* is easy to distinguish from all these species using only external morphological characteristics. In particular, the almost black thorax and first abdominal sternites (only scapular spot yellow) and the broad, almost black forewing discal spot are characteristic. *B. afghana* has abdominal tergite 2 without yellow margin and forewing discal spot yellow distally. *B. guesnoni* and *B. lamai* have abdominal tergite 2 with fine yellow posterior margin and forewing discal spot rather narrow, with distal yellow spot in *B. guesnoni* and discal spot completely yellow in *B. lamai*. In the Hissor-Alai, *B. rushana* often shares the habitat with the superficially rather similar *B. zebo*. This species differs in the smaller forewing discal spot with distinct yellow spot distally, the larger 5-partite external transparent area and the yellow sternite 2 (discal spot without yellow spot, external transparent area 3 or 4 partite, sternite 2 black in *B. rushana*). Also superficially similar, but with a flight period in May/June being much earlier on the wing is *B. kreuzbergi*, which is clearly separated by having the metathorax yellow dorsally. Further species, often occurring syntopically and synchronously, are *B. aye* Stalling, Altermatt, Lingenhöle & Garrevoet, 2010, *B. tshimgana* (Sheljuzhko, 1935), *B. lingenhoelei* Garrevoet & Garrevoet, 2011 and *B. hissorensis*. Both the yellow and black forms of the males of *B. aye* are distinctly larger than *B. rushana* and have forewing veins and margins red anteriorly and external transparent area very large, consisting of 5 cells (wings without red, external transparent area 3 or 4 celled in *B. rushana*). The female of *B. aye* is unknown. Richly yellow marked forms of the very variable *B. tshimgana* are unmistakable in having the forewing discal spot completely orange yellow. Dark forms have a black forewing discal spot, sometimes centrally with small orange dot or a few orange-yellowish scales. They differ from black *B. rushana* in having some tergites and the hindtibia with yellow markings, which are sometimes difficult to discern. Males of *B. tshimgana* differ further in the smaller forewing discal spot, which is nearly as broad as the apical area. Females of *B. tshimgana* have well developed transparent areas of the forewings and the hindwings transparent (both wings opaque in *B. rushana*). Males of *B. lingenhoelei* have smaller transparent areas and only the abdominal tergites 4 and 6 with narrow yellow posterior margin (tergite 2 with narrow, 4, 6 and 7 with broad yellow margin in *B. rushana*). Females of *B. lingenhoelei* are also black but lack the orange-yellow colouration of the head, the forewing lacks transparent areas and has the apex slightly translucent (anterior transparent area very small, but always visible, wing apex intensely black in *B. rushana*). Both sexes of *B. hissorensis* differ in having the tegula cranially, the metathorax dorsally and the sternite 2, 4–6 (and 7 in male) yellow and the forewing discal spot with distinct yellow spot distally, the female is further distinguished by the well developed transparent parts of the wings. Very similar, especially in the female, is *B. salangica* from the Hindu Kush, Afghanistan. This species also has yellow and

Figs 17–21. Habitat and host plants of *Bembecia* species. **17.** Tajikistan, Hissar-Alai, 2 km S of Anzob Pass, habitat of *B. rushana*, *B. hissorensis*, *B. aye*, *B. lingenhoelei* and *B. zebo*. **18, 19.** *Astragalus* sp. host plant of *B. rushana*. **20, 21.** *Astragalus* sp. host plant of *B. hissorensis*; dry leaves showing presence of larva (right).

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21

black forms. The yellow form of the males has the colouration of the body paler, the posterior margin of the tergites narrower and present only on tergites 2, 4 and 6, both forms have the vertex covered with dense, extremely hair-like, greyish scales, and lack the longitudinal transparent area of the forewing. Pale females have the vertex black, tergite 5 with broad yellow posterior margin and the hindwing discal spot rather indistinct (vertex orange, without hair-like scales; tergite 5 and hindwing discal spot black in *B. rushana*), black females of *B. salangica* lack the orange-yellow colouration of the head. There is no phenotypic similarity between *B. rushana* and *B. tancrei* (Püngeler, 1905) as stated by Špatenka et al. (1999). *B. tancrei* is darker and other clear differences are in the narrower abdominal annulations, almost black anal tuft, narrower forewing discal spot, and presence of longitudinal and larger anterior and external transparent areas, the latter consisting of 6 cells.

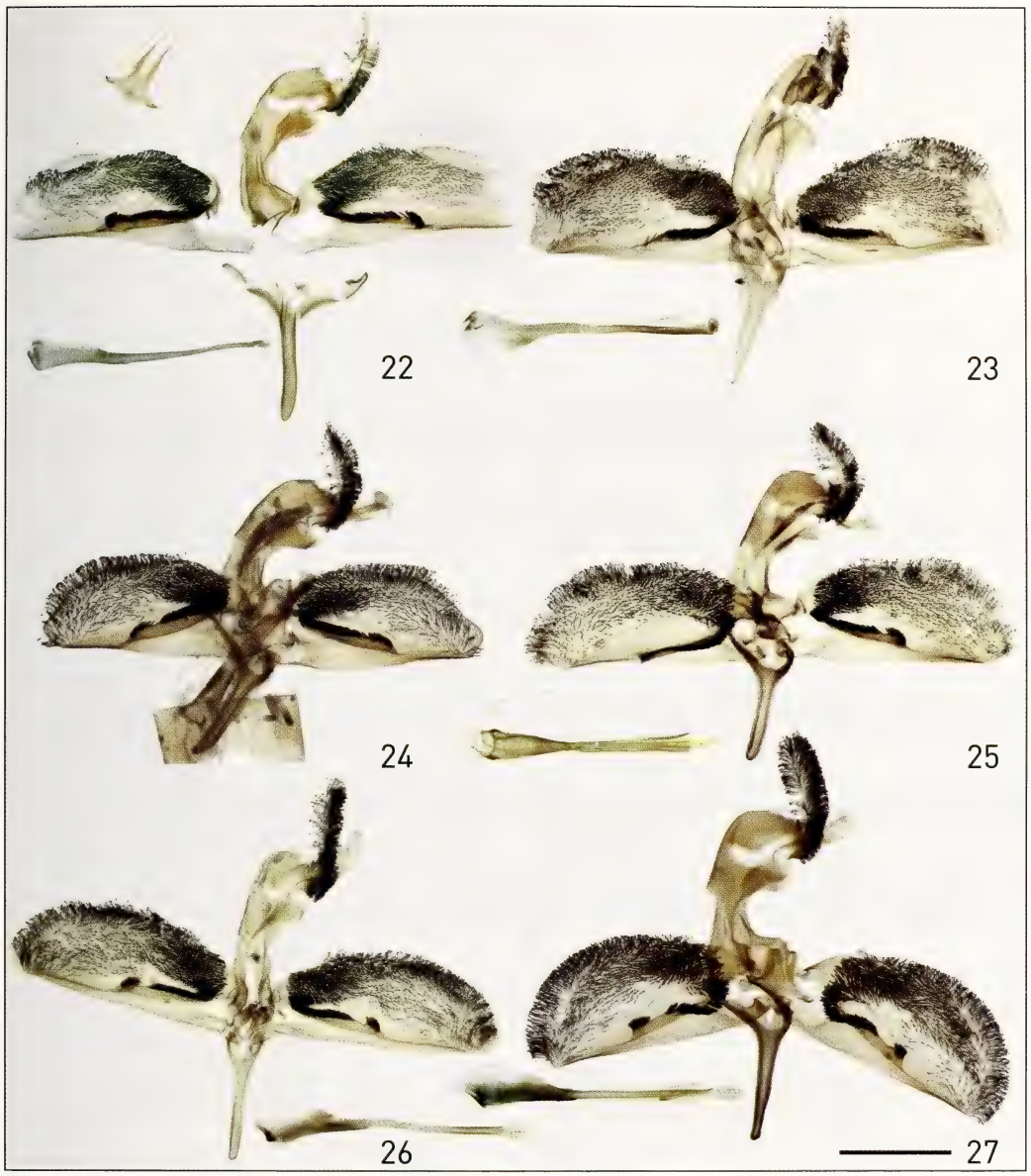
Bionomics. *Bembecia rushana* occurs in dry, stony, often southwards exposed slopes, abrasions and road sides with sparse, predominantly herbaceous vegetation at altitudes from about 2000 m up to 3500 m (Fig. 17). The larva lives apparently two years in the root of an undetermined, non-acanthous species of *Astragalus* L. (Fabaceae) (Fig. 18). In July, infested plants attract attention by the presence of a lot of dry or yellow leaves (Fig. 19). At the time of collection, many larvae had already pupated. Some smaller larvae, not having made their pupal chamber by the end of July apparently needed a second overwintering to complete development. Prior to pupation, the larva constructs a short almost invisible exit tube from the root to the soil surface. The pupal chamber is inside, or along the upper part of the root. Emergence of the imagines always took place in the morning. The species starts to fly in mid-July at altitudes around 2000 m and one or two weeks later at higher altitudes. In culture one male ermerged on September 1 and further three males on September 7, indicating a long flight period of the adults, with its maximum likely in the first half of August. Males are active from late morning to early afternoon. Females were captured in early afternoon flying near the host plant.

Distribution. *Bembecia rushana* is only known from the type locality in the Western Pamir close to the Afghan border, the Peter the First Range in the north-western Pamir and the Hissar-Alai north and east of Dushanbe. All localities are in Tajikistan south of the main range of the Hissar-Alai, which is a distinct faunal boundary line and apparently represents the northern limit of its distribution. Records of *B. rushana* from Afghanistan (Bartsch & Špatenka 2010; Špatenka et al. 1999) refer to *B. salangica*. However, the localities of several finds, including that of the types, are very close to the Afghan border making the occurrence in Afghanistan very likely.

Species confused with *Bembecia rushana*

Bembecia hissorensis Stalling, Bartsch, Garrevoet, Lingenhöle & Altermatt, 2011 — Figs 15, 16

Bembecia hissorensis Stalling, Bartsch, Garrevoet, Lingenhöle & Altermatt 2011: 169. Type locality: Tajikistan, Hissar-Alai, 10 km NW Hissor, N 38°37′42″, E 68°25′33″, 1800 m, 13.vii.2010. Holotype: male (SMNS).



Figs 22–27. Genitalia of *Bembecia rushana* males. **22.** Paratype (ZMKU). **23.** Holotype of *Bembecia karategina* (MWM). **24–27.** Specimens from Khoja Ob-i Garm, showing variability of crista sacculi (CTG, CDB, CAL).

Bembecia hissorensis was described from a large series of 292 males, which were captured in the Hissar-Alai north and south of the main range. Despite the local abundance of the males, female and host plant were unknown. The female paratype of *B. karategina* (Figs 15, 16) belongs to *B. hissorensis*. This is supported by the widely analogous pale yellow colouration shared with the males and from DNA analysis (Fig. A1). This is the only known female of this species and, as *B. karategina*, has been well described and figured in the recent literature (Špatenka 1997, Špatenka et al. 1999). The host

Figs 28, 29. Genitalia structure of *Bembecia rushana* females. **28.** Holotype (ZMKU). **29.** Specimen from Anzob Pass, insert: ostium (CDB).

plant on the south side of the Anzob Pass is a very small, hairy, non-acanthous species of *Astragalus* L. (Figs 20, 21), apparently near *Astragalus heydei* Baker. Only very few larvae/pupae have been found, from which two males emerged.

Bembecia salangica Špatenka & Reshöft, 1989 (not figured)

Bembecia salangica Špatenka & Reshöft, 1989: 178. Type locality: Afghanistan, north side of Salang Pass, 3400 m, 14.vii.1974. Holotype: female (MWM).

Bembecia salangica was described from five females from the Salang Pass, Hindu Kush Mountains. Further specimens were discovered at some other localities in the Hindu Kush, including males, which were described from one specimen from the Anjuman Pass and one from the Comar Valley (Bartsch & Špatenka 2010, Špatenka 1992). Two females from the first locality are figured at the "Barcode of Life" web pages, one of them as *B. rushana*. This is the specimen mentioned and illustrated in the "Handbook of Palaearctic Macrolepidoptera" misidentified as *B. rushana*, representing this species in Afghanistan (Špatenka et al. 1999).

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References

Bartsch, D. & K. Špatenka 2010. *Bembecia magnifica* und *Bembecia afghana*, zwei neue Glasflügler aus Afghanistan (Lepidoptera: Sesiidae). – Entomologische Zeitschrift **120**: 243–248.

BOLD web pages (http://www.barcodinglife.com/views/login.php).

Garrevoet, T. & W. Garrevoet 2011. *Bembecia lingenhoelei*, a new clearwing moth from Tajikistan (Lepidoptera: Sesiidae) – Phegea **39**: 73–79.

Garrevoet, T. & A. Lingenhöle 2011. *Bembecia bartschi*, a new clearwing moth from Tajikistan (Lepidoptera: Sesiidae) – Entomologische Zeitschrift **121**: 157–161.

Gorbunov, O. 1992a. Revision of the types of the Sesiidae (Lepidoptera), preserved in the collection of the Zoological Museum of Kiev State University. – Entomologicheskoe Obozrenie 71: 121–133. [In Russian; English translation in Entomological Review **72**: 40–53; 1993].

Gorbunov, O. 1992b. Two new species of the genus *Bembecia* Hübner, 1819 from Middle Asia (Lepidoptera, Sesiidae). – Atalanta **23**: 249–253.

Lingenhöle, A. & D. Bartsch 2011. *Bembecia garrevoeti* sp. nov. aus dem östlichen Hissargebirge in Tadschikistan (Lepidoptera: Sesiidae) – Entomologische Zeitschrift **121**: 163–167.

Špatenka, K. & K. Reshöft 1989. Eine neue Art der Gattung *Bembecia* Hübner, 1819 aus Ost-Afghanistan (Lepidoptera, Sesiidae). – Entomofauna **10**: 177–186.

Špatenka, K. 1992. Weitere neue paläarktische Sesiiden (Lepidoptera Sesiidae). – Alexanor **17**: 427–446.

Špatenka, K. 1997. Neue Glasflügler (Lepidoptera, Sesiidae) aus dem Pamir und dem Hindukusch. – Bonner Zoologische Beiträge **47**: 31–44.

Špatenka, K., O. Gorbunov, Z. Laštuvka, I. Toševski & Y. Arita 1999. Sesiidae – Clearwings moths. 569 pp. – *In*: C. Naumann (ed.), Handbook of Palaearctic Macrolepidoptera 1. – GEM Publishing Company, Wallingford, England.

Stalling, T., F. Altermatt, A. Lingenhöle & T. Garrevoet 2010. A new species of *Bembecia* Hübner, [1819] from Tajikistan, Central Asia (Lepidoptera: Sesiidae) – Entomologische Zeitschrift **120**: 249–251.

Stalling, T., D. Bartsch, T. Garrevoet, A. Lingenhöle & F. Altermatt 2011. *Bembecia hissorensis*, a new species of Clearwing moths from Tajikistan, Central Asia (Lepidoptera: Sesiidae). – Entomologische Zeitschrift **121**: 169–172.

Appendix

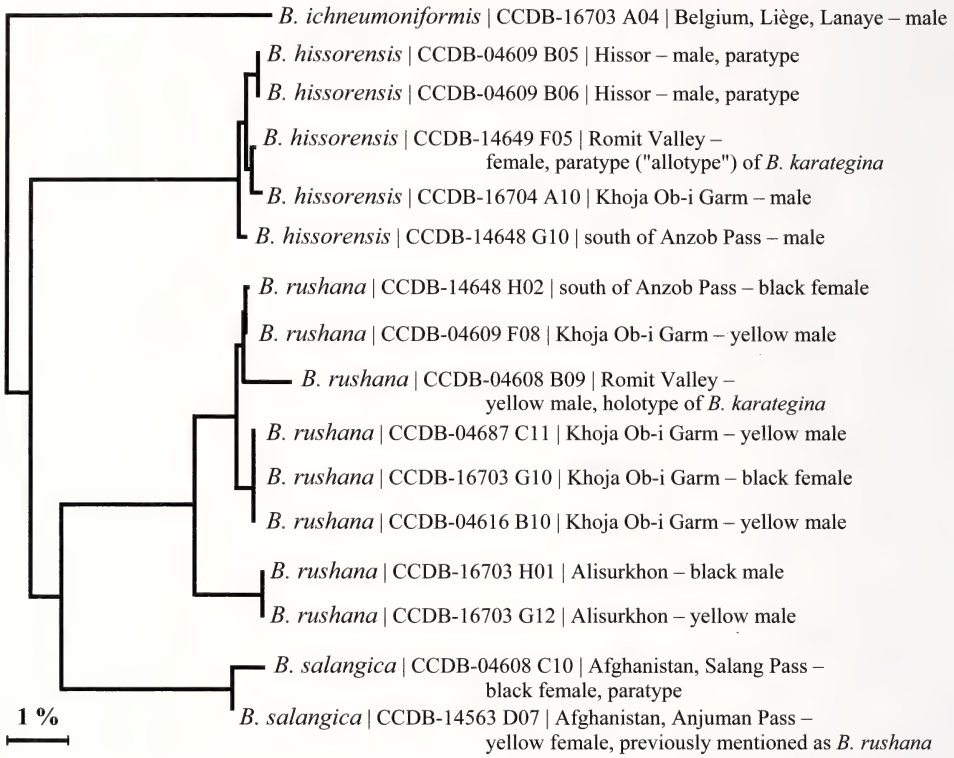

Fig. A1. Neighbour joining tree of DNA barcodes of *Bembecia* species, showing specimen registry numbers and localities of origin (all specimens from Tajikistan, unless stated otherwise). *B. ichneumoniformis* (Denis & Schiffermüller, 1775) is the outgroup.

Dinara Massif – a new hotspot for the butterfly (Papilionoidea) diversity of the Dinaric Arc

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Abstract. The Dinara Massif range is the highest mountain range in Croatia, located in the southeastern part of the country. During the last three years we conducted a butterfly survey on three mountains belonging to the Dinara Massif: Dinara, Kamešnica and Troglav. We recorded 94 butterfly species; for the first time exact localities were given for 46 of them, while two were entirely new records for the area. A comparison with five other mountains belonging to the Dinaric Arc was performed using the Sørensen similarity index, which revealed that Blidinje (Čvrsnica & Vran complex) in Bosnia and Herzegovina, and Mt. Velebit in Croatia have the highest similarity with the Dinara Massif. Several rare species were recorded during this survey, of which *Polyommatus ripartii* (Freyer, 1830) represents the second record for Croatia. The known ranges for *Pieris balcana* (Lorković, 1970), *Polyommatus damon* (Dennis & Schiffermüller, 1775), *Polyommatus eros* (Ochsenheimer, 1808) and *Polyommatus ripartii* in Croatia were much expanded.

Introduction

Butterflies are one of the best studied groups of insects in most of Europe, especially in terms of their biology, distribution (Kudrna et al. 2011), ecology (Settele et al. 2009) and conservation status (van Swaay et al. 2010). One of the commonly used tools to unite all the data in one place are butterfly atlases, which are more the exception than the rule in the Balkan region. Only a single butterfly atlas exists for the region, and it covers the butterflies of Slovenia (Verovnik et al. 2012). In Bosnia and Herzegovina a book covering butterfly diversity exists (Lelo 2007a) but covers only their general distribution, without precise localities. The same goes for the field guide to the butterflies of Serbia (Popović & Đurić 2011). Aside from the 20-year old atlas that covers the entire territory of former Yugoslavia (Jakšić 1988), Croatia, Montenegro and Macedonia do not have any recent atlases. The above mentioned old atlas (Jakšić 1988) gives no data for many areas, and many species were recorded only sporadically. In Croatia, three main biogeographical regions exist: the Mediterranean, the mountain or Dinaric region and the continental region (State Institute for Nature Protection 2011).

One of the most interesting areas for the global species diversity is the Dinaric Arc. This is a south European mountain chain, spanning through Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Serbia and Albania. It extends for 645 kilometers along the coast of the Adriatic Sea (northwest-southeast), from the Julian Alps in the northwest, down to the Šar-Korab massif in the south. The highest mountain of the Dinaric Alps, Maja Jezercë, is 2694 m high. It is located in Mount Prokletije, on the border between Montenegro and northern Albania. The mountain range itself was

named after Mt. Dinara, located at the border of Croatia and Bosnia and Herzegovina. The Dinarides contain a mosaic of Alpine, Continental and Mediterranean species and habitats (Tvrtković & Veen 2006). The geology of the Dinaric Arc mostly consists of carbonate rocks (limestone and dolomite) with islands of clastic rocks and flysch rocks (Gottstein-Matočec 2002). The Dinaric Arc is influenced both by Mediterranean and the Continental climates (Tvrtković & Veen 2006). In fact, the border of those two zones lies along the mountain chain.

Butterflies were sufficiently surveyed only on several mountains belonging to the Dinarides chain, including Učka, Velebit and Biokovo in Croatia, Blidinje in Bosnia and Herzegovina and Durmitor in Montenegro. The highest mountain in Croatia, Dinara, is still a mystery in terms of biodiversity. Recently, an overview paper was published (Tvrtković et al. 2012) in which all the known records for the area were compiled, including literature records. Unfortunately, it lacks precise observation on localities and clear division of literature and recent records. Before that, no systematic surveys were ever carried out in this area, and literature data for the whole Dinara Massif are few (Koren 2010b; Koren et al. 2010; Lorković 2009; Mihoci et al. 2006; Mladinov 1973; Mladinov & Lorković 1985; Sijarić 1977; Stauder 1920/21; Tvrtković et al. 2011). A need for more systematic surveys is emphasised by the fact that for two butterflies, *Colias caucasica* Staudinger, 1871 and *Erebia triaria* (de Prunner, 1798), the Dinara Massif is the only known locality in Croatia (Lorković 2009; Tvrtković et al. 2011).

The aim of this paper is to present newly collected data on the biodiversity of three mountains in the Dinara mountain chain (Troglav, Dinara and Kamešnica), to give an overview of all known butterflies of the region, to present remarks on some interesting species and to compare them to other well-surveyed mountain regions of the Dinarides.

Materials and methods

Study area. The Dinara Massif is characterised by a diverse landscape covered with miscellaneous habitats. All of the surveyed mountains share the same type of vegetation structure. Dinara, Troglav and Kamešnica are mostly covered with different types of grasslands (Fig. 1). There are sub-Mediterranean and epi-Mediterranean dry grasslands that develop on shallow calcareous soil, and occasional meadows on richer brown soil. At higher altitudes are alpine and subalpine grasslands that grow above the tree line. In the past these grasslands were used as pastures or hay meadows, but today after abandonment of traditional outdoor livestock farming they are under severe succession. Dry grasslands are overgrown with scrubs and garrigue and eventually turn into sub-Mediterranean, thermophilous forests and scrubs of *Quercus pubescens* Willd. (Fagaceae), while alpine and subalpine grasslands are exposed to succession with different scrubs or Mountain pine (*Pinus mugo* Turra; Pinaceae). Beside these grasslands, the second most represented habitat types are forests. These are mostly thermophilous forests and scrubs of pubescent oak (*Q. pubescens*) in different degradation stages, and at higher altitudes beech (*Fagus sylvatica* L.; Fagaceae) and pine (*Pinus sylvestris* L. and *Pinus nigra* Arnold; Pinaceae) forests are present (Dumbović et al. 2009).

Fig. 1. a) Troglav, **b**) Kamešnica, Međugorje, **c**) Dinara, Duler, **d**) Dinara, Brezovac.

Data collection. All data presented in this paper are the result of a three-year study by the authors. Dinara was visited in May 2010 and May 2012; Kamešnica in May 2010, and July and August 2012; Troglav in July 2011. These visits covered the whole season of butterfly activity. The visited area of Troglav is especially dangerous, because of many land mines left after the last war twenty years ago. Aside from that, the road leading to the upper part of the mountain is inaccessible by an ordinary vehicle. All these factors make researching this area very dangerous. The survey was carried out on 26 different localities (Tab. 1).

Butterflies were caught with entomological nets, identified, and released on the spot. The sampling was mostly carried out using a transect method, when possible. Time spent on each locality varied, but was at least half an hour per locality. In several cases identification was not possible in the field, so the specimens were collected and the genitalia prepared by standard procedures. Exact coordinates and altitudes were recorded using a Garmin GPS device, altitudes were double-checked in Internet mapping tools (GoogleEarth, GoogleMaps). The taxonomy follows van Swaay et al. (2010).

Data processing. Recorded butterfly diversity was compared to five other, moderately well-surveyed mountains of the Dinaric region. Three of them are located in Croatia – Učka (Rebel 1910), Velebit (Mihoci et al. 2007) and Biokovo (Mihoci et al. 2011), one

Tab. 1. List of surveyed localities on Dinara Massif, with UTM fields, coordinates, altitudinal range and habitat types. ▲Coordinates are set to GCS_Bessel_1841 geographic coordinate system.
* Habitat types: **AG**: alpine and subalpine grasslands, **CS**: cultivated surfaces, **DG**: dry grassland, **FE**: forest edge, **HM**: hay meadow, **P**: pasture, **WB**: water bodies.

	Locality	UTM	Coordinates▲		Altitude range (m a.s.l.)	Habitat*
	Mt. Dinara					
1.	Guge	WJ98	44.06151 N	16.24180 E	245–375	DG, FE, CS, WB
2.	Ćurkove staje	XJ08	44.07236 N	16.27467 E	525–772	DG, HM, P, FE
3.	Matića Guvno	XJ08	44.10240 N	16.30711 E	937–1012	DG, HM, P, FE
4.	Brezovac valley	XJ08	44.10474 N	16.34611 E	1006	AG, HM, P, FE
5.	Duler valley	XJ08	44.08503 N	16.36169 E	1190–1129	AG, HM, P, FE
6.	Smiljina poljana	XJ08	44.07383 N	16.36294 E	1221–1230	AG, FE
7.	Mountain shelter Martinove košare	XJ17	44.04841 N	16.41101 E	1432	AG, FE
8.	Kobilovača	XJ17	44.02824 N	16.41162 E	809–1175	FE
9.	Glavaš	XJ17	44.00999 N	16.42508 E	566	AG, P
	Mt. Troglav					
10.	Jankovo Brdo	XJ27	43.96625 N	16.54635 E	1573–1593	AG
11.	Troglav peak	XJ26	43.94791 N	16.59702 E	1611–1910	AG
12.	Katića Torine	XJ36	43.91892 N	16.61023 E	1393–1530	AG, FE
13.	Popovača area	XJ36	43.87617 N	16.65166 E	1210	AG, FE
14.	Maglaj peak	XJ36	43.87659 N	16.67122 E	1380–1400	AG, P
15.	Mountain house Jakov Bitelić	XJ35	43.85848 N	16.64602 E	1000	P
	Mt. Kamešnica					
16.	Ovrlja spring, at the base	XJ43	43.68173 N	16.75118 E	260	DG, FE, WB, CS
17.	Rože settlement	XJ43	43.66345 N	16.83977 E	772–945	DG, HM, P, FE
18.	Korita village	XJ44	43.70125 N	16.81787 E	688–786	DG, FE, WB
19.	Ruda staje	XJ44	43.69164 N	16.85270 E	1083	DG, FE, P
20.	Međugorje	XJ54	43.69300 N	16.88528 E	1350–1384	AG, FE, HM, P
21.	Mountain shelter Sv. Mihovil	XJ53	43.68595 N	16.88976 E	1208–1348	AG, FE
22.	Arkačica settlement, Mt. Kamešnica	XJ53	43.66302 N	16.91556 E	1012–1030	DG, HM, P, FE
23.	Village Voštane	XJ53	43.64452 N	16.90586 E	865–944	DG, HM, P, CS, FE
24.	Crno polje, Voštane	XJ53	43.61592 N	16.90107 E	765	DG, P, FE
25.	Settlement Vrandolac, Donja Tijarica	XJ53	43.60055 N	16.89362 E	640	DG, FE, P
26.	Settlement Tarabnik, Donja Tijarica	XJ52	43.58835 N	16.90025 E	625	DG, HM, FE

in Bosnia and Herzegovina – Blidinje (Kučinić et al. 2005), and one in Montenegro – Durmitor (Sijarić et al. 1984) (Fig. 2). For the comparison of faunal similarity, we used the widely accepted Sørensen similarity index (Sørensen 1948). This similarity index measures species composition between two different sites, and takes into account the number of species shared by the two sites. The higher the value of the index, the higher the similarity between sites.

Fig. 2. The best surveyed mountains in the Dinaric region: **1**. Mt. Učka, **2**. Mt. Velebit, **3**. Mt. Dinara, **4**. Mt. Biokovo, **5**. Blidinje, **6**. Durmitor.

Results and Discussion

Faunistic data

A comparison of our data with the literature is somewhat challenging, due to the lack of detail in a recent overview done by Tvrtković et al. (2012). In that paper the authors published data from their own survey stretching from the village Guge (250 m a.s.l.) near Knin to the Sinjal peak (1831 m a.s.l.), but without any means of distinguishing between parts of the transects. Additionally, species from a historically surveyed locality near Knin (Hafner 1994) were included. These data are inconclusive due to the fact that the city itself is not part of the discussed area as it is located in the karstic valley of Kninsko Polje, with different geographical, geological, climatological and biodiversity characteristics. The main problem is that Hafner (1994) did not research the mountain itself, but only locations around the city. The best indication of this is the fact that not a single mountain species (e.g., genus *Erebia*) was listed in that paper, even though the survey lasted for several years, and an impressive number of species was recorded. Therefore the main problem is how to distinguish the historical data coming from one small area around the city of Knin, and recent data that include both the city area and

the Mt. Dinara itself. In either case, without exact localities available, the number of 130 recorded species given by Tvrtković et al. (2012) for the whole Dinara Massif should be taken with caution.

During this survey we recorded 94 different butterfly species (Tab. 2). For 46 of those species we provide for the first time their exact localities on the three surveyed mountains. However, 43 of these species were previously mentioned by Tvrtković et al. (2012), and only three are mentioned for the first time: *Pyrgus alveus* (Hübner, 1803), *Polyommatus ripartii* (Freyer, 1830) and *Hipparchia syriaca* (Staudinger, 1871). Looking at each mountain separately, we recorded 40 species on Dinara, 55 species on Troglav, and 58 on Kamešnica. Of those species, two are for the first time recorded on Mt. Dinara, 41 on Mt. Troglav and 30 on Mt. Kamešnica (Tab. 2).

With our newly collected data, and the literature data, the number of butterfly species in the Dinara Massif reaches 128 (Tab. 2). Species listed by Tvrtković et al. (2012), which we have not recorded and were listed only for the Knin area, are excluded from the list.

The results of the first study of the Dinara Massif show that the butterfly diversity of this mountain is high and rank it among the richest regions in Croatia (Mihoci et al. 2011). In Croatia, only Mt. Velebit has more recorded species (Mihoci et al. 2007). The butterfly diversity in the other regions of the country, like northern Croatia or Istria, is significantly lower than in the mountain complexes. Mt. Velebit and the Dinara Massif, for example, are influenced by different climate classes and contain numerous habitats, which result in the variety of butterfly species that occur there.

The Sørensen similarity index showed that the most similar areas to the Dinara Massif are Velebit (82.26%), Durmitor (77.52%) and Blidinje (74.89%) (Tab. 3). This could be expected due to the geographic position of Mt. Dinara, which lies between those three areas. Mts Učka and Biokovo are more isolated from the main Dinaric Arc, and thus have more different fauna.

Of the six compared mountain regions, Velebit and Durmitor have the highest number of recorded species (Tab. 3), probably resulting from more surveys in the past (Mihoci et al. 2007; Sijarić et al. 1984). Blidinje (Mts Čvrsnica & Vran complex) and Učka, with less than 100 recorded species, are probably still insufficiently researched. The situation with Biokovo is probably somewhat different, as it lies outside the main Dinaric chain, and is under a strong influence of the Mediterranean climate, so the 102 recorded species probably represent almost all butterflies present in the area. Although the Dinara Massif in Croatia with its 128 species is probably sufficiently researched, this number should not be considered as final. With our visits we did manage to cover the whole season of butterfly activity, but not in all the different altitudes and habitats. Our estimate is that one could probably expect at least 5–10% more species for the whole Massif, and a larger number of species for both Mt. Troglav and Mt. Kamešnica.

Interesting records

Some of the 94 recorded species require special attention. Both *Pyrgus sidae* (Esper, 1784) and *Pyrgus serratulae* (Rambur, 1839) are considered to be rare and local in Croatia, with only occasional records (Lorković 2009). They do not depend strictly on

Tab. 2. Systematic list of recorded species along with the localities, literature records, and Red List categories. ▲Cases in which genitalia dissection was used. *First record for the mountain. **CRLC – Croatian Red List Category (Šašić & Kučinić 2004). ***IUCN Red List Category for Europe (van Swaay et al. 2010), abbreviations: DD – data deficient, LC – least concern, NT – near threatened, VU – vulnerable, CR – critically endangered.

Species list▲		Locality number			Literature	CRLC**	IUCN***
		Mt. Dinara	Mt. Troglav	Mt. Kamešnica			
	HESPERIIDAE						
1.	*Hesperia comma* (Linnaeus, 1758)				Tvrtković et al. 2012		LC
2.	*Ochlodes sylvanus* (Esper, 1777)		12*		Tvrtković et al. 2012		LC
3.	*Thymelicus acteon* (Rottemburg, 1775)				Tvrtković et al. 2012	DD	NT
4.	*Thymelicus sylvestris* (Poda, 1761)		10, 12*		Tvrtković et al. 2012		LC
5.	*Thymelicus lineola* (Ochsenheimer, 1808)		10, 11, 12*		Tvrtković et al. 2012		LC
6.	*Spialia orbifer* (Hübner, 1823)			22*	Tvrtković et al. 2012		LC
7.	*Erynnis tages* (Linnaeus, 1758)	3, 6, 7, 8, 9		18, 22*	Tvrtković et al. 2012		LC
8.	*Pyrgus malvae* (Linnaeus, 1758)	8		18, 20*	Tvrtković et al. 2012		LC
9.	*Pyrgus armoricanus* (Oberthür, 1910)				Tvrtković et al. 2012		LC
10.	*Pyrgus alveus* (Hübner, 1803)	9*	12*				LC
11.	*Pyrgus serratulae* (Rambur, 1839)		12*		Tvrtković et al. 2012		LC
12.	*Pyrgus sidae* (Esper, 1784)	1, 2, 9			Tvrtković et al. 2012		LC
13.	*Carcharodus flocciferus* (Zeller, 1847)				Tvrtković et al. 2012		NT
14.	*Carcharodus alceae* (Esper, 1780)				Tvrtković et al. 2012		LC
	PAPILIONIDAE						
15.	*Iphiclides podalirius* (Linnaeus, 1758)	1, 8		18, 19, 20, 22, 23	Tvrtković et al. 2012		LC
16.	*Papilio machaon* Linnaeus, 1758	3		18, 20, 22, 23	Tvrtković et al. 2012		LC
17.	*Parnassius mnemosyne* (Linnaeus, 1758)			18*	Stauder 1920/21; Tvrtković et al. 2012	NT	NT
18.	*Parnassius apollo* (Linnaeus, 1758)		10, 11, 12	20	Mladinov 1973; Mladinov & Lorković 1985; Sijarić 1977; Tvrtković et al. 2012	VU	NT
19.	*Zerynthia polyxena* (Denis & Schiffermüller, 1775)	8			Tvrtković et al. 2012	NT	LC

Tab. 2 continued.

Species list▲		Locality number			Literature	CRLC**	IUCN***
		Mt. Dinara	Mt. Troglav	Mt. Kamešnica			
	PIERIDAE						
20.	*Aporia crataegi* (Linnaeus, 1758)		12*		Tvrtković et al. 2012		LC
21.	*Gonepteryx rhamni* (Linnaeus, 1758)	1, 2, 3, 8		18, 20	Stauder 1922; Tvrtković et al. 2012		LC
22.	*Pieris brassicae* (Linnaeus, 1758)	8			Tvrtković et al. 2012		LC
23.	*Pieris ergane* (Geyer, 1828)	1, 2, 8	12*	18,23	Mihoci et al. 2006; Tvrtković et al. 2012		LC
24.	*Pieris mannii* (Mayer, 1851)				Mihoci et al. 2006; Stauder 1913; Tvrtković et al. 2012		LC
25.	*Pieris rapae* (Linnaeus, 1758)	8		20, 23*	Tvrtković et al. 2012		LC
26.	*Pieris napi* (Linnaeus, 1758)	1			Sijarić 1977; Tvrtković et al. 2012		LC
27.	*Pieris balcana* Lorković, 1968		12*		Tvrtković et al. 2012		LC
28.	*Anthocharis cardamines* (Linnaeus, 1758)	2, 8		18*	Tvrtković et al. 2012		LC
29.	*Pontia edusa* (Fabricius, 1777)			21*	Tvrtković et al. 2012		LC
30.	*Colias caucasica* (Staudinger, 1871)				Tvrtković et al. 2011; Tvrtković et al. 2012		LC
31.	*Colias croceus* (Fourcroy, 1785)		11*	22, 23	Mihoci et al. 2006; Tvrtković et al. 2012		LC
32.	*Colias alfacariensis* Ribbe, 1905	1		18, 20, 26*	Sijarić 1977; Tvrtković et al. 2012		LC
33.	*Leptidea sinapis* (Linnaeus, 1758)▲	8	12*	21, 22*	Tvrtković et al. 2012		LC
	LYCAENIDAE						
34.	*Satyrium acaciae* (Fabricius, 1787)				Sijarić 1977		LC
35.	*Satyrium ilicis* (Esper, 1779)		12*	21	Sijarić 1977; Tvrtković et al. 2012		LC
36.	*Satyrum spini* (Dennis & Schiffermüller, 1775)		14*	21*	Mladinov 1973; Tvrtković et al. 2012		LC
37.	*Callophrys rubi* (Linnaeus, 1758)	1, 6, 7		19*	Tvrtković et al. 2012		LC
38.	*Favonius quercus* (Linnaeus, 1758)		12*		Tvrtković et al. 2012		LC
39.	*Leptotes pirithous* (Linnaeus, 1767)				Tvrtković et al. 2012		LC

40.	*Lycaena alciphron* (Rottemburg, 1775)				Tvrtković et al. 2012		LC
41.	*Lycaena candens* (Herrich-Schäffer, 1844)				Tvrtković et al. 2012		LC
42.	*Lycaena phleas* (Linnaeus, 1761)		12*	18, 20, 21*	Tvrtković et al. 2012		LC
43.	*Lycaena tityrus* (Poda, 1761)				Tvrtković et al. 2012		LC
44.	*Lycaena virgaureae* (Linnaeus, 1758)		12*		Sijarić 1977; Tvrtković et al. 2012		LC
45.	*Cupido minimus* (Fuessly, 1775)	4, 5, 9	10*	21*	Tvrtković et al. 2012		LC
46.	*Cupido osiris* (Meigen, 1829)				Tvrtković et al. 2012		LC
47.	*Celastrina argiolus* (Linnaeus, 1758)	8			Tvrtković et al. 2012		LC
48.	*Plebejus argus* (Linnaeus, 1758)		11, 12, 14*	22*	Tvrtković et al. 2012		LC
49.	*Plebejus argyrognomon* (Bergsträsser, 1779)				Tvrtković et al. 2012		LC
50.	*Aricia agestis* (Dennis & Schiffermüller, 1775)	8, 9	12*	18, 19, 22, 23	Mihoci et al. 2006; Tvrtković et al. 2012		LC
51.	*Aricia artaxerxes* (Fabricius, 1793)		10*		Mihoci et al. 2006; Tvrtković et al. 2012		LC
52.	*Aricia eumedon* (Esper, 1780)				Sijarić 1977		LC
53.	*Cyaniris semiargus* (Rottemburg, 1775)		11, 12*		Sijarić 1977; Tvrtković et al. 2012		LC
54.	*Glaucopsyche alexis* (Poda, 1761)	8			Tvrtković et al. 2012	NT	LC
55.	*Phengaris arion* (Linnaeus, 1758)				Tvrtković et al. 2012	DD	EN
56.	*Phengaris alcon rebeli* (Hirschke, 1904)		12, 14*		Tvrtković et al. 2012	CR	LC
57.	*Scolitantides orion* (Pallas, 1771)	8			Tvrtković et al. 2012	NT	LC
58.	*Pseudophilotes vicrama* (Moore, 1865)	7, 8*	11	18, 22, 23, 24*	Tvrtković et al. 2012	DD	NT
59.	*Iolana iolas* (Ochsenheimer, 1816)	1			Tvrtković et al. 2012		NT
60.	*Polyommatus eros* (Ochsenheimer, 1808)		11*	20, 21, 22, 23*	Tvrtković et al. 2012		NT
61.	*Polyommatus icarus* (Rottemburg, 1775)	1, 2, 3, 9	10, 11*	16, 17, 18, 21, 22, 23, 24	Mihoci et al. 2006; Tvrtković et al. 2012		LC
62.	*Polyommatus thersites* (Cantener, 1835)			17, 22	Mihoci & Šašić 2006; Tvrtković et al. 2012		LC
63.	*Polyommatus amandus* (Schneider, 1792)	1	11*		Tvrtković et al. 2012		LC
64.	*Polyommatus admetus* (Esper, 1783)			26*	Koren 2010; Tvrtković et al. 2012		LC

Tab. 2 continued.

Species list▲		Locality number			Literature	CRLC**	IUCN***
		Mt. Dinara	Mt. Troglav	Mt. Kamešnica			
	PIERIDAE						
65.	*Polyommatus damon* (Denis & Schiffermüller, 1775)		14, 15*	20, 21	Mihoci et al. 2006		NT
66.	*Polyommatus escheri* (Hübner, 1823)				Tvrtković et al. 2012		LC
67.	*Polyommatus dorylas* (Denis & Schiffermüller, 1775)	2, 3, 4	11*	17, 22	Mihoci et al. 2006; Tvrtković et al. 2012		NT
68.	*Polyommatus bellargus* (Rottemburg, 1775)			17, 18	Mihoci et al. 2006; Tvrtković et al. 2012		LC
69.	*Polyommatus coridon* (Poda, 1761)			17, 18, 22, 23, 24	Mihoci et al. 2006; Sijarić 1977; Tvrtković et al. 2012		LC
70.	*Polyommatus daphnis* (Denis et Schiffermüller, 1775)				Tvrtković et al. 2012		LC
71.	*Polyommatus ripartii* (Freyer, 1830)		15*	20, 22*			LC
	RIODINIDAE						
72.	*Hamearis lucina* (Linnaeus, 1758)				Tvrtković et al. 2012		LC
	NYMPHALIDAE						
73.	*Libythea celtis* (Laicharting, 1782)			22	Mihoci et al. 2006; Mladinov 1973; Tvrtković et al. 2012		LC
74.	*Limenitis reducta* Staudinger, 1901	1	12*	16, 18, 22, 23	Mihoci et al. 2006; Tvrtković et al. 2012		LC
75.	*Neptis rivularis* (Scopoli, 1763)			20*	Tvrtković et al. 2012		LC
76.	*Nymphalis antiopa* (Linnaeus, 1758)				Tvrtković et al. 2012		LC
77.	*Nymphalis polychloros* (Linnaeus, 1758)				Tvrtković et al. 2012		LC
78.	*Vanessa atalanta* (Linnaeus, 1758)	1	12*	19	Mihoci et al. 2006; Tvrtković et al. 2012		LC
79.	*Vanessa cardui* (Linnaeus, 1758)	3		20*	Tvrtković et al. 2012		LC
80.	*Aglais io* (Linnaeus, 1758)	1			Sijarić 1977; Tvrtković et al. 2012		LC
81.	*Aglais urticae* (Linnaeus, 1758)	8		16*	Sijarić 1977; Tvrtković et al. 2012		LC

82.	*Polygonia c-album* (Linnaeus, 1758)				Tvrtković et al. 2012		LC
83.	*Argynnis adippe* (Denis & Schiffermüller, 1775)		12		Sijarić 1977; Tvrtković et al. 2012		LC
84.	*Argynnis aglaja* (Linnaeus, 1758)		10, 11, 12	18, 20*	Tvrtković et al. 2012		LC
85.	*Argynnis pandora* (Denis & Schiffermüller, 1775)		12*		Mladinov 1973; Tvrtković et al. 2012		LC
86.	*Argynnis paphia* (Linnaeus, 1758)		12	20, 21	Mihoci et al. 2006; Sijarić 1977; Tvrtković et al. 2012		LC
87.	*Issoria lathonia* (Linnaeus 1758)	6	12	18, 20*	Sijarić 1977; Tvrtković et al. 2012		LC
88.	*Brenthis daphne* (Bergsträsser, 1780)				Tvrtković et al. 2012		LC
89.	*Brenthis hecate* (Dennis & Schiffermüller, 1775)				Sijarić 1977; Tvrtković et al. 2012		LC
90.	*Boloria euphrosyne* (Linnaeus, 1758)				Tvrtković et al. 2012		LC
91.	*Melitaea didyma* (Esper, 1778)		12*	20, 23*	Mladinov 1973; Tvrtković et al. 2012		LC
92.	*Melitaea phoebe* (Denis & Schiffermüller, 1775)		12*		Tvrtković et al. 2012		LC
93.	*Melitaea trivia* (Denis et Schiffermüller, 1775)				Tvrtković et al. 2012		LC
94.	*Melitaea cinxia* (Linnaeus, 1758)	8, 9		18*	Tvrtković et al. 2012		LC
95.	*Melitaea diamina* (Lang, 1789)				Tvrtković et al. 2012		LC
96.	*Melitaea athalia* (Rottemburg, 1775) ▲		11, 12*		Tvrtković et al. 2012		LC
97.	*Melitaea britomartis* Assmann, 1847▲		11		Koren & Jugovic 2012	DD	NT
98.	*Euphydryas aurinia* (Rottemburg, 1775)	1, 2, 8, 9		18*	Tvrtković et al. 2012	DD	LC
99.	*Melanargia galathea* (Linnaeus, 1758)		10, 11, 12, 14*	18, 20, 22, 23	Sijarić 1977; Stauder 1922; Tvrtković et al. 2012		LC
100.	*Melanargia larissa* (Geyer, 1828)				Tvrtković et al. 2012		LC
101.	*Hipparchia fagi* (Scopoli, 1763) ▲		12*	18, 22	Mladinov 1973; Tvrtković et al. 2012		NT
102.	*Hipparchia syriaca* (Staudinger, 1871) ▲			22, 23*			LC
103.	*Hipparchia semele* (Linnaeus, 1758)		11*	18, 22	Mihoci et al. 2006; Mladinov 1973; Sijarić 1977; Tvrtković et al. 2012		LC
104.	*Neohipparchia statilinus* (Hufnagel, 1766)				Tvrtković et al. 2012		NT

Tab. 2 continued.

Species list▲		Locality number			Literature	CRLC**	IUCN***
		Mt. Dinara	Mt. Troglav	Mt. Kamešnica			
	NYMPHALIDAE						
105.	*Arethusana arethusa* (Denis & Schiffermüller, 1775)			22, 23*	Tvrtković et al. 2012		LC
106.	*Brintesia circe* (Fabricius, 1775)		11, 12, 13, 14*	21, 23, 24	Mihoci et al. 2006; Tvrtković et al. 2012		LC
107.	*Chazara briseis* (Linnaeus, 1764)		15*	20, 22, 25	Mihoci et al. 2006; Mladinov 1973; Sijarić 1977; Tvrtković et al. 2012		NT
108.	*Satyrus ferula* (Fabricius, 1793)		11, 12, 13	16, 21, 26*	Tvrtković et al. 2012		LC
109.	*Erebia aethiops* (Esper, 1777)				Tvrtković et al. 2012		LC
110.	*Erebia euryale* (Esper, 1805)		12		Sijarić 1977; Tvrtković et al. 2012		LC
111.	*Erebia ligea* (Linnaeus, 1758)		12		Mladinov & Lorković 1985; Tvrtković et al. 2012		LC
112.	*Erebia melas* (Herbst, 1796)		10, 11, 12*		Lorković 2009; Mladinov 1973; Stauder 1922; Tvrtković et al. 2012		LC
113.	*Erebia oeme* (Hübner, 1804)		10, 11		Mladinov & Lorković 1985; Sijarić 1977; Tvrtković et al. 2012		LC
114.	*Erebia ottomana* Herrich-Schäffer, 1847		10, 11, 12		Lorković 2009; Mladinov & Lorković 1985; Tvrtković et al. 2012		LC
115.	*Erebia medusa* (Denis & Schiffermüller, 1775)	3, 4			Mladinov 1973; Mladinov & Lorković 1985; Tvrtković et al. 2012	DD	LC
116.	*Erebia triaria* (de Prunner, 1798)	5, 6			Lorković 2009; Mladinov & Lorković 1985; Tvrtković et al. 2012		LC
117.	*Proterebia afra* (Fabricius, 1787)	8, 9		18	Koren et al. 2010; Tvrtković et al. 2012	DD	LC
118.	*Hyponephele lycaon* (Kühn, 1774)		12*	20	Sijarić 1977; Tvrtković et al. 2012		LC
119.	*Hyponephele lupina* (Costa, 1836)				Mladinov 1973		LC
120.	*Maniola jurtina* (Linnaeus, 1758)		13, 15*	16, 17, 21, 22	Mihoci et al. 2006; Sijarić 1977; Tvrtković et al. 2012		LC
121.	*Coenonympha arcania* (Linnaeus, 1761)				Sijarić 1977; Tvrtković et al. 2012		LC

122.	*Coenonympha glycerion* (Borkhausen, 1788)		10, 11, 12	20*	Tvrtković et al. 2012	LC
123.	*Coenonympha pamphilus* (Linnaeus, 1758)	3, 4, 9		18, 22, 23	Mihoci et al. 2006; Tvrtković et al. 2012	LC
124.	*Coenonympha rhodopensis* Elwes, 1900		11		Mladinov 1973; Sijarić 1977; Tvrtković et al. 2012	LC
125.	*Pyronia tithonius* (Linnaeus, 1758)				Tvrtković et al. 2012	LC
126.	*Lasiommata maera* (Linnaeus, 1758)				Mihoci et al. 2006; Tvrtković et al. 2012	LC
127.	*Lasiommata megera* (Linnaeus, 1767)	1, 2, 8		18, 19, 20	Sijarić 1977; Tvrtković et al. 2012	LC
128.	*Pararge aegeria* (Linnaeus, 1758)	2			Tvrtković et al. 2012	LC

higher altitudes, but records are most common there. Having no recent records for either of the two species in Croatia, these records from the Dinara Mountain chain are important. In Bosnia and Herzegovina, only several records of these species exist, and they are generally local and rare (Lelo 2007b). In nearby Montenegro, these species are more widespread and present on several localities (Jakšić 1988).

Arguably the best known European mountain butterfly, *Parnassius apollo* (Linnaeus, 1758) has previously been recorded only on the Bosnian side of Troglav (Sijarić 1977). Our records prove that this species is present also on the Croatian side, as it has been recorded both on Troglav and Kamešnica. It can be found on a few mountains in the Gorski Kotar region, as well as on Mt. Velebit (Lorković 2009). As this species was not present on Mt. Biokovo (Mihoci et al. 2011), these records probably represent the southernmost records in Croatia.

The most interesting Pieridae species recorded was *Pieris balcana* (Lorković, 1970). The main distinguishable characteristic between *P. balcana* and *P. napi* is the amount of black or greenish suffusion on the lower side of hindwing. While in *P. napi* the suffusion usually extends to the end of the wing, in *P. balcana* the suffusion is limited only to the cell and the beginning of the veins (Lorković 1989). Our record represents the only recent record as *P. balcana* was last recorded more than 20 years ago (Lorković 1989). It is probably more common in the area than previous records suggest (Lorković 1989), but due to its morphology which is very similar to *P. napi*, it was probably overlooked in many areas. The closest known localities of this species are Zelengora and Trebević in Bosnia and Herzegovina (Lorković 1989). The closest record in Croatia comes from Trnovac, located about 100 kilometers to the northwest. With our new record from Mt. Troglav, the known range in Croatia is significantly increased towards the south.

Iolana iolas (Ochsenheimer, 1816) is a Mediterranean species, in Croatia distributed mostly in the coastal zones, with rare isolated populations in the continental part (Krčmar 2002). In general, this species is not rare in Croatia, but is mostly local, limited

Tab. 3. The Dinaric Mountains with the best-surveyed butterfly faunas, along with the highest altitude, the number of recorded species, and the Sørensen similarity index between Dinara Massif and the other mountain regions.

Mountain	Highest altitude	Number of species	Sørensen similarity index
Učka	1401 m	89	71.89%
Velebit	1757 m	137	82.26%
Dinara	1913 m	128	—
Biokovo	1762 m	102	73.91%
Blidinje	2228 m	91	74.89%
Durmitor	2523 m	130	77.52%

to areas with its larval food plant, *Colutea arborescens* L. (Leguminosae). We recorded a single male on the foothills of Mt. Dinara, in the area with no larval food plant, so this individual may well represent a wandering individual. Such a case was also recorded on Mt. Velebit (Lorković 2009).

During our visit to Mt. Troglav in July, special attention was given to searching for eggs of *Phengaris alcon* (Dennis & Schiffermüller, 1775) on *Gentiana cruciata* L. (Gentianaceae). Adults were not recorded probably because it was late in the season, but we managed to find several eggs at two localities on Mt. Troglav. Approximately 20 plants were examined per locality, and on four of them we detected eggs. This species is probably more common in the area, and more targeted surveys are needed.

Polyommatus thersites (Cantener, 1835) is generally considered to be a rare species in Croatia (Mihoci et al. 2006), but recent records (Koren & Ladavac 2010; Koren et al. 2011) indicate that it is probably more common and widespread in the country. The species was recorded on both Troglav and Kamešnica in fair numbers.

The only lycaenid species recorded during this survey that inhabits only the higher altitudes was *Polyommatus eros* (Ochsenheimer, 1808). All literature records for this species originate from Mt. Velebit (Grund 1916; Lorković 2009; Steiner 1938) and Mt. Dinara, where it was mentioned as "common, but restricted to the highest altitudes" without exact locality (Tvrtković et al. 2012). Our record from the border area of Mts Troglav and Kamešnica between Croatia and Bosnia and Herzegovina significantly expands the known range in Croatia. This species was common in the area of Mt. Troglav at altitudes above 1500 m. Interestingly, on Mt. Kamešnica it was recorded at 800 m a.s.l., which is probably one of the lowest records for this species in general (Tolman & Lewington 2008).

While the presence of *Polyommatus admetus* (Esper, 1785) has previously been confirmed for Mt. Dinara (Koren 2010b), Mt. Kamešnica is a new locality. This is the commonest species of "brown" lycaenids in Croatia. It is present in several areas of southern Croatia, and generally local, but occasionally numerous (Koren 2010b).

The second species belonging to this group, *Polyommatus damon* (Denis & Schiffermüeller, 1775), has been recorded only twice before in Croatia (Koren et al. 2011; Mihoci et al. 2006). The first known locality of this species was Mt. Kamešnica (Mihoci et al. 2006), where we confirmed its presence, and we added another locality on Mt. Troglav. Both populations from Mts Kamešnica and Troglav were very numerous (Fig. 3), with

Fig. 3. *Polyommatus damon* resting on grass, Mt. Troglav.

a high number of recorded specimens. For example, on Mt. Troglav, in a small surface area of 2 × 2 m^2, more than 20 individuals were counted resting at sunset.

Probably one of the most interesting findings was *Polyommatus ripartii* (Freyer, 1830). This species was only recently confirmed for the butterfly fauna of Croatia (Koren 2010a). During our survey we recorded it on both Mt. Kamešnica and Mt. Troglav. In contrast to *P. damon*, *P. ripartii* was very rare on Troglav, and only a single specimen was recorded. On the other hand, on Mt. Kamešnica the population was very numerous, and more than 50 individuals were observed during our visits. These two records significantly expand the known distribution of this species in Croatia towards the south. In neighbouring Bosnia and Herzegovina, this species is also considered to be rare, with only a single confirmed record (Lelo 2007a).

One of the most interesting recorded nymphalid species was *Neptis rivularis* (Scopoli, 1763). The main area of occurrence of this species in Croatia is the northern part of the country, with just a few records from the southern part. The closest record of this species originates from Mt. Dinara (Tvrtković et al. 2012). Only a single individual was observed on Mt. Kamešnica.

From the 7 recorded species of the genus *Erebia*, probably the most notable record is that of *Erebia triaria* (de Prunner, 1798). This species was recorded previously from the area of Dinara (Lorković 2009; Mladinov & Lorković 1985; Tvrtković et al. 2012) and until now remained the only known locality in Croatia. Due to the unusually early flight period (May), and similar appearance to that of *Erebia medusa* (Denis & Schiffermüller, 1775), this species is easily overlooked. We observed this species on two localities on Dinara, where it was relatively numerous.

Of the 94 recorded species, several are of conservation concern. Some of the species are listed on the Red list of butterflies of Croatia (Šašić & Kučinić 2004) as Critically endangered (CR), Vulnerable (VU), Near Threatened (NT), or Data Deficient (DD): *Phengaris alcon* (CR); *Parnassius apollo* (VU); *Parnassius mnemosyne* (Linnaeus, 1758), *Zerynthia polyxena* (Denis & Schiffermüller, 1775), *Glaucopsyche alexis* (Poda, 1761), *Scolitantides orion* (Pallas, 1771) (NT); and *Pseudophilotes vicrama* (Moore, 1865), *Erebia medusa*, *Euphydryas aurinia* (Rottemburg, 1775), *Melitaea britomartis* Assmann, 1847 and *Proterebia afra* (Fabricius, 1787) (DD).

Ten recorded species are listed as Near Threatened in the European Red Butterfly list (van Swaay et al. 2010): *Parnassius apollo*, *Parnassius mnemosyne*, *Iolana iolas*,

Polyommatus damon, *Polyommatus dorylas* (Denis & Schiffermüller, 1775), *Polyommatus eros*, *Pseudophilotes vicrama*, *Chazara briseis* (Linnaeus, 1764), *Hipparchia fagi* (Scopoli, 1763) and *Melitaea britomartis*.

Altogether, 17 species are listed in one of the mentioned red lists. This, along with previously mentioned interesting species records, shows the importance and diversity of the surveyed area. Some species recorded during previous surveys, especially by Tvrtković et al. (2012), were not confirmed during our research. The comparison of our results with the literature is somewhat difficult, as we mostly concentrated on Mts Kamešnica and Troglav, while Tvrtković et al. (2012) concentrated mostly on Mt. Dinara. However, the differences in recorded number of species are not surprising, as the Dinara Massif is a large region, with a high number of different habitats, and we managed to visit only a small part of it. Future visits to the same localities, but in different months, should yield higher number of species for each surveyed locality.

Conclusions

The Dinara Massif, which includes four main mountains (Ilica, Dinara, Troglav and Kamešnica), is certainly one of the richest areas in the Dinaric Arc in terms of butterfly diversity. With our records and the literature records, a total of 128 species is known for the area. This number will probably grow in the future, and more new records are to be expected. Special attention should be given to Ilica Mountain, for which no data on butterfly diversity are available. One of the reasons why these mountains were not recently surveyed is their inaccessibility, especially due to the minefields left after the last war. In a certain way this favours biodiversity, because it limits human impact on the area. On the other hand, these areas are left to succession, especially after the abandonment of the traditional outdoor livestock farming.

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References

Dumbović, V., A. Duplić, K. Fabrio, D. Jelić, L. Katušić, G. Krivanek, K. Leko, D. Marković, P. Oković, V. Posavec Vukelić, P. Oković, G. Šestani, I. Zupan, G. Zwicker Kompar & I. Žeger Pleše 2009. Tech report: Dinara – Assembly elaborate. State Institute for Nature Protection, Zagreb. 151 pp.

Gottstein-Matočec, S. (ed.) 2002. An overview of the cave and interstitial biota of Croatia. – Entomologia Croatica **11**: suppl. 1, 112 pp.

Grund, A. 1916. Beiträge zur kroatischen Lepidopeteren-Fauna. – Glasnik Hrvatskog prirodoslovnog društva **28** (1–2): 95–105; (3–4): 114–168.

Hafner, I. 1994. Verzeichnis der bei Knin gesammelten Schmetterlinge (Lepidoptera). – Natura Croatica **3** (2): 119–184.

Jakšić, P. 1988. Provisional distribution maps of the butterflies of Yugoslavia (Lepidoptera, Rhopalocera). – Jugoslavensko Entomološko društvo, Zagreb, posebna izdanja [special issue] **1**, 215 pp.

Koren, T. 2010a. First finding of Ripart's Anomalous Blue *Polyommatus* (*Agrodiaetus*) *ripartii* (Freyer, 1830) (Lepidoptera, Lycaenidae) in Croatia. – Natura Croatica **19** (2): 463–467.

Koren, T. 2010b. New data about the distribution of anomalous blue *Polyommatus admetus* (Esper, 1783) (Lepidoptera: Lycaenidae) in Croatia. – Acta entomologica Serbica **15** (2): 221–226.

Koren, T. & L. Ladavac 2010. Butterfly fauna (Lepidoptera: Hesperioidea & Papilionoidea) of Central Istria (Croatia). – Natura Croatica **19** (2): 369–380.

Koren, T., I. Burić, A. Štih, V. Zakšek & R. Verovnik 2010. New data about the distribution and altitudinal span of the dalmatian ringlet, *Proterebia afra dalmata* (Godart, 1824) (Lepidoptera: Satyrinae) in Croatia. – Acta Entomologica Slovenica **18** (2): 143–150.

Koren, T., M. Bjelić, E. Božinovska, A. Štih & I. Burić 2011. Contribution to the knowledge of butterfly fauna (Lepidoptera: Rhopalocera) of Zrmanja River region, Croatia. – Acta Entomologica Slovenica **19** (2): 155–168.

Koren, T. & J. Jugovic 2012. New data on the presence of the three similar species of the genus *Melitaea*: *M. athalia*, *M. aurelia* and *M. britomartis* (Lepidoptera: Nymphalidae) in the North-western Balkans. – Annales **22** (1): 25–34.

Krčmar, S. 2002. Data on the butterfly fauna of the Croatian part of Baranja (Lepidoptera, Rhopalocera). – Bulletin de la Société Royale Belge d'Entomologie **138** (2):151–153.

Kučinić, M., S. Stanić, P. Durbešić, I. Mihoci, N. Landeka & A. Delić 2005. A review of research into butterflies (Lepidoptera: Rhopalocera) in Blidinje nature park (Bosnia and Herzegovina). – Entomologia Croatica **9**: 11–28.

Kudrna, O., A. Harpke, K. Lux, J. Pennerstorfer, O. Schweiger, J. Settele & M. Wiemers 2011. Distribution Atlas of Butterflies in Europe. – Gesellschaft für Schmetterlingsschutz, Halle.

Lelo, S. 2007a. Dnevni leptiri Bosne i Hercegovine. – Prirodno-matematički fakultet Univerziteta u Sarajevu, Sarajevo. 337 pp.

Lelo, S. 2007b. Contribution to knowledge of the fauna of butterflies in Bosnia and Herzegovina. – Acta entomologica serbica **12** (2): 73–92.

Lorković, Z. 1989. Der Karyotypus und die reproduktiven Beziehungen des Taxon *balcana* Lorković 1968 zu *Pieris napi* Linnaeus 1758 und *P. pseudorapae* Verity 1908 (Lepidoptera, Pieridae). – Glasnik Zemaljskog muzeja Bosne i Hercegovine **28**: 155–175.

Lorković, Z. 2009. The Rhopalocera Fauna of Croatia with Special Respect to the Fauna of Plitvice Lakes. – Entomologia Croatica **13**: 15–78.

Mihoci, I. & M. Šašić 2006. Novi podaci o proširenju vrste *Polyommatus thersites* (Cantener, 1835) (Lepidoptera: Lycaenidae) u Hrvatskoj. – Entomologia Croatica **10** (2): 7–14.

Mihoci, I., M. Vajdić & M. Šašić 2006. The status of the Damon Blue *Polyommatus* (*Agrodiaetus*) *damon* (Denis and Schiffermüller, 1775) (Papilionoidea: Lycaenidae, Polyommatini) in the Croatian butterfly fauna. – Natura Croatica **15**: 15–25.

Mihoci, I., M. Šašić & M. Vuković 2007. Contribution to the butterfly fauna (Hesperioidea & Papilionoidea) of the Velebit Mountain, Croatia. – Natura Croatica **16**: 29–62.

Mihoci, I., V. Hršak, M. Kučinić, V. Mičetić Stanković, A. Delić & N. Tvrtković 2011. Butterfly diversity and biogeography on the Croatian karst mountain Biokovo: Vertical distribution and preference for altitude and aspect. – European Journal of Entomology **108**: 623–633.

Mladinov, L. 1973. Lepidoptera (Rhopalocera) zbirki Hrvatskog narodnog zoološkog muzeja u Zagrebu. – Hrvatski narodni zoološki muzej. Zagreb **7**: 1–125.

Mladinov, L. & Z. Lorković 1985. Rasprostranjenje montanih Macrolepidoptera u fauni SR Hrvatske, Jugoslavija. – Acta entomologica Jugoslavica **21** (1–2): 17–36.

Popović, M. & M. Đurić 2011. Dnevni leptiri Srbije – priručnik. – HabiProt, Beograd. 198 pp.

Rebel, H. 1910. Lepidopteren aus dem Gebiete des Monte Maggiore in Istrien. – Jahresbericht des Wiener Entomologischen Vereins **21**: 97–110.

Šašić, M. & M. Kučinić 2004. Danji leptiri. Pp. 71–74. – *In*: D. Marković (ed.), Crveni popis ugroženih biljaka i životinja Hrvatske. – Državni zavod za zaštitu prirode, Zagreb.

Settele, J., T. Shreeve, M. Konvicka & H. Van Dyck (eds) 2009. Ecology of butterflies in Europe. – Cambridge University Press. 526 pp.

Sijarić, R. 1977. Faunistički prikaz Rhopalocera i Hesperioidea zapadne Bosne (Lepidoptera). – Glasnik zemaljskog Muzeja Bosne i Hercegovine **16**: 175–192.

Sijarić, R., Z. Lorković, J. Carnelutti & P. Jakšić 1984. Rhopalocera (Insecta, Lepidoptera). Pp. 95–184. – *In*: G. Nonveiller (ed.), The fauna of Durmitor, Part 1. – The Montenegrin Academy of Sciences and Arts, Special Editions 18, Section of Natural Sciences 11, Titograd.

Sørensen, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species and its application to analyses of the vegetation on Danish commons. – Det Kongelige Danske Videnskabernes Selskab. Biologiske Skrifter **5** (4): 1–34.

State Institute for Nature Protection 2011. EU Biogeographical Regions of Croatia. GIS shape file (according: European Comission (2011): Map of EU biogeographic regions EU 27+1, Doc. Hab. 11-05/04).

Stauder, H. 1913. Weitere Beiträge zur Kenntnis der Makrolepidopterenfauna der adriatischen Küstengebiete. – Bollettino della Società Adriatica di Scienze Naturali in Trieste **27** (1): 105–166.

Stauder, H. 1920/21. Die Schmetterlingsfauna der illyro-adriatischen Festland- und Inselzone (Faunula Illyro-Adriatica). – Zeitschrift für wissenschaftliche Insektenbiologie Berlin **16** (1/2): 16–23; (3/4): 43–49; (5/6): 101–108; (7/8): 143–153; (9/10): 166–176; (11/12): 219–224.

Stauder, H. 1922. Die Schmetterlingsfauna der illyro-adriatischen Festland- und Inselzone (Faunula Illyro-Adriatica). – Zeitschrift für wissenschaftliche Insektenbiologie Berlin **17** (1/2): 14–21; (3/4): 58–64; (5/6): 83–92; (7/8): 135–147; (9/12): 165–176.

Steiner, S. 1938. Der heutige Stand der Rhopalocera- und Hesperiidae-Arten für die Lepidopterenfauna Kroatiens. – Internationale Entomologische Zeitschrift **42**: 373–375.

Tolman, T. & R. Lewington 2008. Butterflies of Britain & Europe. – Harper Collins Publishers, London. 384 pp.

Tvrtković, N. & P. Veen (eds) 2006. The Dinaric Alps: Rare habitats and species. Conservation Project in Croatia. Part A. – Hrvatski prirodoslovni Muzej and Royal Dutch Society for Nature Conservation (KNNV). 67 pp.

Tvrtković, N., I. Mihoci & M. Šašić 2011. *Colias caucasica balcanica* Rebel, 1901 (Pieridae) in Croatia – the most western distribution point. – Natura Croatica **20** (2): 375–385.

Tvrtković, N., M. Šašić, M. Vuković, I. Mihoci & M. Bjelić 2012. Review of the butterfly fauna (Hesperioidea & Papilionoidea) of the Dinara mountain range. – Natura Croatica **21** (2): 471–481.

van Swaay, C., A. Cuttelod, S. Collins, D. Maes, M. Lopez Munguira, M. Šašić, J. Settele, R. Verovnik, T. Verstrael, M. Warren, M. Wiemers & I. Wynhof 2010. European red List of Butterfies. – Publications Office of the European Union, Luxembourg.

Verovnik, R., F. Rebeušek & M. Jež 2012. Atlas dnevnih metuljev (Lepidoptera: Rhopalocera) Slovenije [Atlas of Butterflies (Lepidoptera: Rhopalocera) of Slovenia] – Center za kartografijo favne in flore, Miklavž na Dravskem polju. 456 pp.

Faunistic notes on Lepidoptera collected from arctic tundra in European Russia

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Abstract. The insect fauna of European arctic tundra is seriously understudied in contrast to the well-documented subarctic Fennoscandian fauna. We report the results of a survey made on Kara Sea coast near Amderma (N 69°46′, E 61°40′) from 18 June to 3 August 2012. This survey yielded 156 specimens of 29 species of Lepidoptera, 16 of which are new for the Nenets Autonomous Okrug. Noteworthy is the discovery of *Gnorimoschema vastificum* Braun, 1929, so far known only from North America. Two Holarctic species, *Greya variabilis* Davis & Pellmyr, 1992 and *Udea alaskalis* (Gibson, 1920), and four Palaearctic species, *Eucosma ommatoptera* Falkovitsh, 1965, *Pediasia zellerella* (Staudinger, 1899), *Udea uralica* Slamka, 2013 (recently described from the Asiatic slopes of Polar Ural Mts) and *Xanthorhoe uralensis* Choi, 2003, are for the first time reported from Europe (in the strict geographical sense). The fauna of the surroundings of Amderma is dominated by Holarctic species, most of which are confined to tundra habitats.

Introduction

Arctic habitats have always fascinated entomologists, although only a few of them were ready to spend several months in hostile and mosquito-infested tundra environments in order to collect a few dozens of moths and butterflies. Therefore the faunistic data on Lepidoptera from the European Arctic are scarce, except for the relatively well-known but species-poor and isolated Svalbard Archipelago with only three local species (Coulson 2007). Historical data exist for Novaya Zemlya (Jacobson 1898; Rebel 1923), with 14 species included in the recent version of the Fauna Europaea (Karsholt et al. 2012). The Finnish entomologist Poppius (1906) reported 27 species of Lepidoptera from the Kanin Peninsula. Recently, Bolotov (2011) discovered in the Kanin Peninsula 29 species of butterflies, 14 of which were collected in Arctic tundra. He also reported six species of butterflies from the Kolguev Island north of the Kanin Peninsula (Bolotov 2011). Further to the East, in the Bolshezemelskaya Tundra, the region administratively belonging to the Nenets Autonomous Okrug and the Republic of Komi, Tatarinov and Kulakova (2005) recorded 61 species of butterflies. We are not aware of any data on Lepidoptera from the Yugorsky Peninsula, which lies very close to the north-eastern corner of continental Europe.

In summer of 2012, the Northern (Arctic) Federal University situated in Arkhangelsk organised an expedition to Amderma. Although the expedition focused on the investi-

gation of ground beetles (Carabidae), it also resulted in the collection of representative material of Lepidoptera. Keeping in mind the acute shortage of faunistic information from the arctic regions of European Russia we publish the list of collected species along with short comments.

Material

Amderma (N 69°46′, E 61°40′) is a small, nowadays nearly abandoned settlement in the Nenets Autonomous Okrug within the Arkhangelsk Oblast in Russia. It is located in Yugorsky Peninsula at the coast of the Kara Sea (Fig. 1), within the zone of low-shrub tundra (as defined by Walker et al. 2005). July is warmest with an average temperature of 7.3°C, and January is coldest with an average temperature of −21.3°C; annual precipitation amounts 326 mm.

Moths and butterflies were generally collected within 10 km distance from Amderma; therefore we do not report an exact sampling site. This area (5 to 70 m in elevation) is mostly covered by different types of tundra, but also includes meadows associated with small rivers and ravines, and bogs (Figs 2–5). Description of the vegetation in 14 plots of 10 × 10 m size revealed 96 species of vascular plants, among which the most common were *Dryas octopetala* L. (Rosaceae), *Carex norvegica* Retz. (Cyperaceae), *Myosotis caespitosa* Schultz (Boraginaceae), *Pachypleurum alpinum* Ledeb. (Apiaceae), *Poa alpina* L. (Poaceae), *Salix arctica* Pallas, *S. lanata* L., *S. polaris* Wahlenb. and *S. reticulata* L. (Salicaceae). Species richness of vascular plants within a plot varied from 7 to 37 species (the mean being 18 species), and vegetation cover varied from 40 to 98% (the mean being 80%).

Moths and butterflies were searched for during regular excursions from 18 June to 3 August 2012 and collected by netting. Some specimens were sampled from plants. Sweep-netting brought no results. Lepidopteran larvae were also collected by pitfall trapping, but this material is not yet identified. The specimens are deposited in the Finnish Natural History Museum (Helsinki).

In the following list, an asterisk (*) denotes species that have not yet been recorded from Europe in the strict geographical sense, i.e. from areas to the west from the dividing ridge of the Polar Ural Mts. This is done to minimize the possibility of confusion between geographical, biogeographical and administrative borders; our approach in no way compromises the understanding of the European fauna as accepted by Fauna Europaea, the project which covers the entire Ural Mts and does not follow regional borders (Karsholt et al. 2012). Note that in the checklist of the Lepidoptera of Russia (Sinev 2008) the entire regions 5 and 6 (jointly including Arkhangelsk Oblast and the Republic of Komi) belong to Europe, as well as the westernmost parts of the regions 15 (Northern Ural Mts) and 18 (Yamalo-Nenetskij Autonomous Okrug), whereas the eastern parts of regions 15 and 18 belong to Asia. A degree sign (°) indicates species that are for the first time reported from the Nenets Autonomous Okrug (region 5 in Sinev 2008). An exclamation mark (!) indicates species that had not been included in the Fauna Europaea (Karsholt et al. 2012) by April 1, 2013.

Fig. 1. Location of Amderma.

Figs 2–5. Examples of habitats near Amderma. **2.** Alpine meadow near small river. **3.** Alpine meadow on south-facing slope. **4.** Willow-*Dryas* tundra. **5.** Meadow on sandy soils, with a bog behind.

List of species

PRODOXIDAE

***!*Greya variabilis* Davis & Pellmyr, 1992**

Carex-moss bog, 9.vii, 2 exx. This Holarctic species was described from North America in 1992 and later on reported from the Chukchi Peninsula (Kozlov 1996) and Taimyr Peninsula (Kozlov et al. 2006). In the Palaearctic it is known only from tundra, but in the Nearctic it occurs also in moist coniferous forests.

TINEIDAE

°*Tineola bisselliella* (Hummel, 1823)

Indoors, 3.viii, 2 exx. Synantropic species that was originally confined to the western Palaearctic, but is now introduced to all regions.

PLUTELLIDAE

***Plutella xylostella* (Linnaeus, 1758)**

Willow-moss tundra, 22.vi, 2 exx. Willow-grass tundra, 7.vii, 1 ex. Cosmopolitan. Generally considered as migrant in the Arctic (Makarova et al. 2012).

GELECHIIDAE

***!*Gnorimoschema vastificum* Braun, 1929** **Fig. 6**

Stony willow tundra, 9.vii, 12 exx. The species is similar to *G. bodillum* Karsholt & Nielsen, 1974 described from coastal sand dune areas of the North Sea. The morphological similarity between *G. vastificum* and *G. bodillum* had been already noted by Povolný (2002) and O. Karsholt (pers. comm.). However, the moths from Amderma differ from both these species by black forewings with few scattered whitish and orange brown scales, while both legs and the underside of the body are covered mainly by whitish scales. Our identification is primarily based on the results of DNA sequencing: our specimen is placed within a clade consisting of several dozens of specimens of *G. vastificum* from Canada and Alaska, but substantially differs from *G. bodillum* from Denmark (J.-F. Landry, V. Nazari & M. Mutanen, unpublished data in BOLD). It may indeed happen that the specimens from sandy riverbank in Taymyr Peninsula, identified as *G. bodillum* by Bidzilya (2005), belong to the same taxon, because the moths from Taimyr were almost black in contrast to sandy brownish colouration of the Danish specimens. Interestingly, the habitat in Amderma does not include open sands, but tundra with *Salix arctica* and *S. rotundifolia*.

°***Bryotropha galbanella*** (Zeller, 1839)

Willow-*Dryas* tundra, 29.vii, 5 exx.; 9.vii, 1 ex. Stony willow tundra, 9.vii, 1 ex. Stony *Arctous-Empetrum* tundra, 9.vii, 1 ex. Willow-grass tundra, 7.vii, 1 ex. Holarctic boreal species living on mosses.

TORTRICIDAE

Apotomis frigidana **(Packard, 1867)**

Stony shrubby tundra, 9.vii, 1 ex. Willow-*Dryas* tundra, 29.vii, 1 ex. Infrequent Holarctic species, which is not recorded in Fennoscandia.

Argyroploce noricana **(Herrich-Schäffer, 1851)**

Alpine meadow, 29.vi, 1 ex.; 7.vii, 1 ex.; 17.vii, 6 exx.; 19.vii, 2 exx. Stony shrubby tundra, 7.vii, 1 ex. *Rubus chamaemorus*-sedge bog, 9.vii, 1 ex. *Dryas*-moss tundra, 9.vii, 25 exx. Stony dwarf shrub tundra, 17.vii, 3 ex. Willow-*Dryas* tundra, 9.vii, 2 exx.; 19.vii, 1 ex.; 29.vii, 1 ex. This European arctoalpine species whose larvae feed on *Dryas* was most common in the study area, where the moths were observed on flowers of *Polygonum viviparum*.

Phiaris inquietana **(Walker, 1863)**

Willow-*Dryas* tundra, 9.vii, 1 ex. This Holarctic arctoalpine tundra species in Europe has only been found in Nenets Autonomous Okrug (Sinev 2008) and Polar Ural Mts (Polyarnyi Ural station: J. K., pers. obs.).

Phiaris obsoletana **(Zetterstedt, 1839)**

Alpine meadow, 7.vii, 1 ex.; 17.vii, 1 ex. *Carex*-moss bog, 9.vii, 2 exx. Meadow on sandy soil in a ravine, 11.vii, 1 ex. Sedge-moss bog, 19.vii, 1 ex. *Dryas*-moss tundra, 29.vii, 1 ex. Willow-*Dryas* tundra, 19.vii, 1 ex. Palaearctic boreomontane species typical for boreal bogs.

Phiaris turfosana **(Herrich-Schäffer, 1851)**

Stony willow tundra, 19.vii, 1 ex. Holarctic boreomontane species typical for boreal bogs.

Gypsonoma parryana **(Curtis, 1835)**

Alpine meadow, 7.vii, 5 exx.; 17.vii, 3 exx. Willow-grass tundra, 7.vii, 4 exx. Willow-*Dryas* tundra, 7.vii, 1 ex.; 9.vii, 2 exx.; 19.vii, 1 ex.; 29.vii, 1 ex. *Dryas*-moss tundra, 1.vii, 3 exx. Holarctic tundra species which in Europe has only been reported from Novaya Zemlya (Rebel 1923).

*!***Eucosma ommatoptera*** **Falkovitsh, 1965**

Meadow on sandy soil in a ravine, 27.vi, 1 ex. Alpine meadow, 7.vii, 1 ex. Willow-

Dryas tundra, 29.vii, 1 ex. Earlier reported from Taimyr (Kozlov et al. 2006) and the Russian Far East, from Chukotka to Primorye region (Sinev 2008).

PTEROPHORIDAE

°***Platyptilia calodactyla*** **(Denis & Schiffermüller, 1775)**

Carex-moss bog, 9.vii, 1 ex. Sedge-moss bog, 19.vii, 1 ex. A widely distributed Palaearctic species.

°!***Paraplatyptilia sibirica*** **Zagulajev, 1983**

Carex-moss bog, 9.vii, 1 ex. Sedge-moss bog, 19.vii, 1 ex. Palaearctic tundra species which in Europe has only been reported from the north-eastern part of the Komi Republic (Sinev 2008).

PYRALIDAE

°***Catastia kistrandella*** **Opheim, 1963**

Dryas-moss tundra, 9.vii, 1 ex.; 29.vii, 1 ex. Palaearctic subalpine and tundra species which is distributed from northern Fennoscandia to Chukotka.

****Pediasia zellerella*** **(Staudinger, 1899)**

Carex-moss bog, 9.vii, 2 exx. Sedge bog, 9.vii, 1 ex. Alpine meadow, 17.vii, 1 ex. Described from Altai Mts; recently found in Taymyr (Kozlov et al. 2006). Common in surroundings of Vorkuta in the north-eastern corner of European Russia and in Polar Ural Mts (J. K., pers. obs.).

*!***Udea alaskalis*** **(Gibson, 1920)** **Fig. 7**

Alpine meadow, 29.vi, 1 ex. Willow-grass tundra, 7.vii, 1 ex. High arctic species described from Alaska, which in Palaearctic has been reported only from Chukotka (Sinev 2008). The species is closely related to *U. torvalis* (Möschler) occurring in the Nearctic and Greenland.

*!***Udea uralica*** **Slamka, 2013**

Willow-grass tundra, 17.vii, 2 exx. The species has recently been described from the Asiatic slopes of Polar Ural Mts (Slamka 2013); it is also known from the Altai and Sayan Mts (S. Sinev, pers. comm.).

PIERIDAE

Aporia crataegi **(Linnaeus, 1758)**

Ruderal habitat, 27.vi, 1 ex. Palaearctic, most likely a migrant.

GEOMETRIDAE

***Psychophora sabini* (Kirby, 1824)**

Willow-moss tundra, 22.vi, 2 exx. Holarctic species.

****Xanthorhoe uralensis*** Choi, 2003

Alpine meadow, 29.vi, 3 exx. Sedge bog, 9.vii, 1 ex. A recently described species (Choi 2003), which was so far known only from Krasnyi Kamen in the eastern (Asiatic) slopes of the Polar Ural Mts but was attributed to the European fauna by Hausmann & Viidalepp (2012). A member of the taxonomically challenging Holarctic *X. incursata* group consisting of several closely related allopatric taxa: Central European *X. incursata* (Hübner, 1813), Fennoscandian *X. annotinata* (Zetterstedt, 1839), *X. pseudoannotinata* Vasilenko, 2007 from South Urals, south Siberian *X. sajanaria* (Prout, 1914) and east Siberian *X. derzhavini* (Djakonov, 1931).

***Entephria punctipes* (Curtis, 1835)**

Rubus chamaemorus-sedge bog, 9.vii, 1 ex. Sedge bog, 9.vii, 1 ex. Nival meadow, 19.vii, 2 exx. Willow-*Dryas* tundra, 29.vii, 1 ex. Holarctic species.

°***Dysstroma pseudimmanata*** (Heydemann, 1929)

Sedge bog, 9.vii, 1 ex. The only previous record from Europe originates from South Ural Mts (Hausmann & Viidalepp 2012); also found in Polar Ural Mts near Krasnyi Kamen (J. K., pers. obs.). Widely distributed through Siberia to Kamchatka and Japan; recently, on the basis of mtDNA analysis, reported from North America (Hausmann & Viidalepp 2012).

EREBIDAE

°***Pararctia subnebulosa tundrana* Tshistjakov, 1990**

Willow-grass tundra, 7.vii, 1 ex. A Holarctic tundra species, which in Europe has only been found in the easternmost part of the Republic of Komi (Polyarnyi Ural station: Tatarinov et al. 2003). Nominal subspecies described from North America.

NOCTUIDAE

°***Syngrapha hochenwarthi* (Hochenwarth, 1785)**

Meadow on sandy soil in a ravine, 27.vii, 1 ex. A subalpine Holarctic species.

°***Sympistis zetterstedtii* (Staudinger, 1857)**

Dryas-moss tundra, 18.vi, 1 ex. Sedge bog, 9.vii, 1 ex. *Dryas*-moss tundra, 9.vii, 2 exx. Willow-*Dryas* tundra, 9.vii, 1 ex.; 19.vii, 4 exx.; 29.vii, 1 ex. *Rubus chamaemorus*-

sedge bog, 29.vii, 1 ex. Alpine meadow, 8.viii, 1 ex. The taxonomic status of this Holarctic species is controversial. We accept it after Lafontaine & Schmidt (2013) who consider *S. zetterstedtii* as a northern Holarctic species which is separate of *S. nigrita* occurring in Alps.

***Polia richardsoni* (Curtis, 1835)**

Alpine meadow, 29.vii, 1 ex. Holarctic, circumpolar.

***Xestia liquidaria* (Eversmann, 1848)**

Carex-moss bog, 9.vii, 1 ex. *Rubus chamaemorus*-sedge bog, 9.vii, 1 ex. Stony willow tundra, 9.vii, 1 ex. Willow-*Dryas* tundra, 9.vii, 1 ex. Holarctic species with partly brachypterous females, earlier known in Europe only from Novaya Zemlya (Rebel 1923). This typical arctic tundra species was described originally as a geometroid moth from "Steppen der Kirgisen" (mainly Kazakhstan) which is an obvious mislabelling (Fibiger 1993) as there are no suitable habitats.

***Xestia quieta* (Hübner, 1813)**

Alpine meadow, 29.vi, 1 ex. A typical Holarctic species inhabiting stony scree slopes in Fennoscandia and Polar Ural Mts.

Discussion

Although the number of Lepidoptera species collected from the arctic tundra surrounding Amderma is relatively low, the discovered fauna shows an unexpectedly high (1.64) ratio between the numbers of so-called 'microlepidoptera' to 'macrolepidoptera'. This ratio is even higher than in the Murmansk region of Russia (1.52: Kozlov & Kullberg 2010), the lepidopteran fauna of which is best studied among the regions of Russia (Sinev 2008). This finding strongly suggests that the extremely low proportion of 'microlepidoptera' reported so far from the Nenets Autonomous Okrug (0.59: Sinev 2008) reflects the insufficient level of knowledge due to common sampling bias towards 'macrolepidoptera', rather than predominance of the latter group in the arctic fauna.

The largest part of Lepidoptera recorded in Amderma (19 species; 66%) is widely distributed, with 17 species having a Holarctic range, and two being cosmopolitan (*Plutella xylostella*, *Tineola bisselliella*). This proportion may appear even higher, because some Palaearctic species, like *Catastia kistrandella* (distributed from Northern Fennoscandia to Chukotka), are likely to be discovered in North America, too. In this respect the fauna of Amderma resembles the fauna of Taimyr, which included 45% of Holarctic and cosmopolitan species (Kozlov et al. 2006). The difference between the faunas of Amderma and Taimyr can be attributed to the presence of boreal forests in the southern parts of Taimyr Peninsula, while Amderma is located in arctic tundra. Consequently, about one third of species collected from Amderma were not found outside the tundra habitats (including those confined to alpine regions).

Figs 6, 7. Interesting species collected from Amderma. **6.** *Gnorimoschema vastificum* Braun, 1929. **7.** *Udea alaskalis* (Gibson, 1920).

Surprisingly, seven of the 29 species collected from Amderma are new for Europe (in the strict geographical sense), including *Gnorimoschema vastificum* which is new for the entire Palaearctic region. However, since the fauna of Ural Mts hardly differs on European and Asiatic sides, the finding of two of these species (*Udea uralica* and *Xanthorhoe uralensis*) in Europe was quite predictable, as they were already known from the Asiatic slopes of Polar Ural Mts. More than a half (16 of 29) species collected from Amderma appeared new for the Nenets Autonomous Okrug, thus increasing the number of species recorded in this region from 108 (Sinev 2008) to 124.

The records of the expedition to Amderma revealed how easy it is to discover new and unexpected species of Lepidoptera for Europe in the tundra of European Russia if you just get there. Only a handful of locations scattered over the vast area covered by tundra in the north-eastern part of Europe have been collected until the present day (and even then only poorly sampled). The opening of the Iron Curtain has not much encouraged the entomological studies of the Russian polar regions even in the light of actively continuing international debates on global warming. The effects of this phenomenon on insect fauna are expressed, in particular, in shifting the distributional range of butterflies towards the North (Parmesan et al. 1999). Therefore we are in serious danger of losing the knowledge of the present distribution of Lepidoptera species in the area where the global effect is hitting hard and the expected warming may move species distributions hundreds of kilometres towards the north.

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References

Bidzilya, A. V. 2005. On the distribution of Gelechiid Moths (Lepidoptera, Gelechiidae) in Siberia. Contribution 2. – Proceedings of Zoological Museum, Taras Shevchenko National University in Kiev **3**: 7–19. [In Russian, English summary].

Bolotov, I. N. 2011. Fauna and ecology of butterflies (Lepidoptera, Rhopalocera) from Kanin Peninsula and Kolguev Island. – Zoologicheskij Zhurnal **90**: 1365–1373. [In Russian, English abstract].

Choi, S. W. 2003. A new species of *Xanthorhoe* Hübner (Lepidoptera: Geometridae: Larentiinae) from Polar Urals, Russia. – Journal of the Kansas Entomological Society **76**: 125–130.

Coulson, S. J. 2007. The terrestrial and freshwater invertebrate fauna of the High Arctic archipelago of Svalbard. – Zootaxa **1448**: 41–58.

Fibiger, M. 1993. Noctuinae II. Noctuidae Europaeae **2**. – Entomological Press, Sorø. 230 pp.

Hausmann, A. & J. Viidalepp 2012. Larentiinae I., The Geometrid Moths of Europe, Vol. **3**. – Apollo Books, Stenstrup, 743 pp.

Jacobson, G. G. 1898. Zoological investigation on Novaya Zemlya in 1896. The insects of Novaya Zemlya. – Mémoires de l'Académie des sciences de St.-Pétersbourg. VIIIe série. Classe des sciences physiques et mathématiques **8**: 171–244. [in Russian].

Karsholt, O., E. J. van Nieukerken & Y. S. D. M. de Jong 2012. Lepidoptera, Moths. – Fauna Europaea version 2.5, http://www.faunaeur.org.

Kozlov, M. V. 1996. Incurvariidae and Prodoxidae (Lepidoptera) from Siberia and the Russian Far East, with descriptions of three new species. – Entomologica Fennica **7**: 55–62.

Kozlov, M. V., J. Kullberg & V. V. Dubatolov 2006. Lepidoptera of the Taymyr Peninsula, northwestern Siberia. – Entomologica Fennica **17**: 136–152.

Kozlov, M. V. & J. Kullberg 2010. New and interesting records of Lepidoptera from the Kola Peninsula, northwestern Russia, in 2000–2009. – Entomologica Fennica **21**: 254–272.

Lafontaine, J. D. & B. C. Schmidt 2013. Comments on differences in classification of the superfamily Noctuoidea (Insecta, Lepidoptera) between Eurasia and North America. – ZooKeys **264**: 209–217.

Makarova, O. L., A. V. Sviridov & M. A. Klepikov 2012. Moths and butterflies (Lepidoptera) of polar deserts. – Zoologicheskij Zhurnal **91**: 1043–1057. [In Russian].

Parmesan, C., N. Ryrholm, C. Stefanescu, J. K. Hill, C. D. Thomas, H. Descimon, B. Huntley, L. Kaila, J. Kullberg, T. Tammaru, W. J. Tennent, J. A. Thomas & M. Warren 1999. Poleward shifts in geographical ranges of butterfly species associated with regional warming. – Nature **399**: 579–583.

Poppius, B. R. 1906. Beiträge zur Kenntniss der Lepidopteren-Fauna der Halbinsel Kanin. – Acta Societatis pro Fauna et Flora Fennica **28** (3): 1–11.

Povolný, D. 2002. Iconographia tribus Gnorimoschemini (Lepidoptera, Gelechiidae) regionis Palaearcticae. – Franisek Slamka, Bratislava. 110 pp.

Rebel, H. 1923. Lepidoptera von Novaja Semlja. – Report of the Scientific Results of the Norwegian Expedition to Novaya Zemlya 1921, **7**: 1–15.

Sinev, S. Yu. (ed.) 2008. Catalogue of the Lepidoptera of Russia. – KMK Scientific Press, St. Petersburg & Moscow. 424 pp. [In Russian.]

Slamka, F. 2013. Pyraloidea of Europe, Vol. **3**, Pyraustinae and Spilomelinae – F. Slamka, Bratislava. 357 pp.

Tatarinov, A. G. & O. I. Kulakova 2005. Butterflies (Lepidoptera, Rhopalocera) of the Bolshezemelskaya tundra in the northeast of the European part of Russia. – Euroasian Entomological Journal **4**: 331–337.

Tatarinov, A. G., K. F. Sedykh & M. M. Dolgin 2003. Higher heteroceran Lepidoptera. Fauna of the European North-East of Russia, Vol. **7**, pt. 2. – Nauka, Moscow. 223 pp. [In Russian.]

Walker, D. A., M. K. Raynolds, F. J. A. Daniëls, E. Einarsson, A. Elvebakk, W. A. Gould, A. E. Katenin, S. S. Kholod, C. J. Markon, E. S. Melnikov, N. G. Moskalenko, S. S. Talbot, B. A. Yurtsev & the other members of the CAVM Team 2005. The Circumpolar Arctic vegetation map. – Journal of Vegetation Science **16**: 267–282.

Checklist of the butterflies (Papilionoidea) of the Saur Mountains and adjacent territories (Kazakhstan), including systematic notes about the *Erebia callias* group

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Abstract. A checklist of Papilionoidea of the Saur Mountains is presented with 159 butterfly species (Hesperiidae: 15; Papilionidae: 7; Pieridae: 17; Nymphalidae: 71; Lycaenidae: 49). The specific status of *Erebia sibirica* Staudinger, 1881 is confirmed. *Araschnia levana* (Linnaeus, 1758), *Clossiana selenis* (Eversmann, 1837), *Phengaris alcon* (Denis & Schiffermüller, 1775) and *Aricia nicias* (Meigen, 1829) are reported for the Saur for the first time.

Introduction

The Saur is a small mountain range which is a part of the Tarbagatai mountain system; it is situated on the border between Eastern Kazakhstan and China south-eastwards from Zaisan lake and the Black Irtysh River (Figs 1–6). To the north it is bordered by the Zaisan depression, and the Chilikty depression separates it from the Tarbagatai in the south. In its western part the Saur is in contact with the small Manrak range and in the north-eastern part with the Saikan range. The Saur stretches 140 km from the west to the east and reaches an altitude of 3816 m (Muztau Mt.). Average temperature in January is –20°C, in July +22°C. Annual average precipitation is 350–500 mm. The humidity rises with altitude, and the temperature falls. The snow line is situated at an altitude of 3300 m in the Saur, and hence its peaks are always covered by snow. Glaciers are situated in the Muztau Mt.; the largest one reaches an area of 4–5 km^2.

The north foot of the Saur up to 700 m belongs to the semi-desert zone where semi-desert plants grow on solonetzic chestnut soil. In the mountains north slopes are covered by mountain forests consisting of *Pinus sibirica* Du Tour, *Abies sibirica* Ledeb. and *Picea tianschanica* Rupr. (Bykov) (Pinaceae) (Bolshakov 1987), meadows and thick brakes with *Berberis* (Berberidaceae), *Daphne* (Thymelaeaceae), *Spiraea*, *Crataegus*, *Rosa* (all Rosaceae) etc. South expositions are covered by mountain steppes and semi-deserts. Alpine meadows, stony mountain tundras and glaciers are situated on the crests. The hydrographic network is developed very well; the main rivers are Zhemenei and Uidene.

The biogeographic affiliation of the Saur is controversial. In the beginning of the last century the Saur was regarded as part of Dzhungaria and even Tien-Shan, but later the Saur and Tarbagatai were considered as a separate mountain biogeographic regions on a level with the Altai, Dzhungarsky Alatau and Tien-Shan. De Lattin (1967) includ-

ed Saur Mountains in "Turkestanische Zentrum, Tarbagataische Sekundärzentrum". Emeljanov (1974) clearly placed it as "Tarbagatai subregion of Altai complex region of Westscythian subprovince of Scythian province". Kryzhanovsky (2002) included Saur in the "Kazakhstanian province of Centralasian superprovince". Maloletko (1999) argued that the Saur and the Tarbagatai belong to the system of the Altai mountains and this view was held by leading Russian botanists (Kamelin 2005) who include these ridges within the Altai-Dzhungarian biogeographical region. Later some entomologists working on the fauna of the Altai mountain system accepted the demarcation of the Altai as suggested by phytogeographs (Volynkin & Matov 2011; Yakovlev 2012). Our opinion agrees with this latter demarcation and is confirmed by the absence of some Dzhungarian taxa in the fauna of the Saur and Tarbagatai: the family Riodinidae, the genera *Marginarge* Korb, 2005 and *Karanasa* Moore, 1893 (Nymphalidae: Satyrinae), and the subgenus *Koramius* Moore, 1902 (Papilionidae).

Additionally, there are many typical Siberian species and species with arcto-alpine disjunction in the fauna of the Saur and Tarbagatai where they occur in the southernmost edge of their distributions. The most typical examples are *Parnassius tenedius* Eversmann, 1851 (Papilionidae), *Clossiana freija* (Thunberg, 1791), *C. frigga* (Thunberg, 1791), *Boloria altaica* Grum-Grzhimailo, 1893, *Euphydryas iduna* (Dalman, 1816), *Mellicta menetriesi* Caradja, 1895 (Nymphalidae), and *Agriades glandon* (de Prunner, 1798) (Lycaenidae). Most of them have well-differentiated subspecies in the fauna of the Saur and Tarbagatai (e.g., *C. frigga annae* Suschkin, 1906, *E. iduna jacobsoni* Yakovlev, 2011, *M. menetriesi saurica* Yakovlev, 2007, *Agriades glandon rubini* Churkin, 2007). In our opinion, one of the most important points in the analysis of faunistic similarities and differences, and analyses of their origin, is the evaluation of the relationships of endemic species. The majority of endemics of the Saur and Tarbagatai (*Erebia haberhaueri* Staudinger, 1881, *E. sibirica* Staudinger, 1881, *Oeneis fulla* (Eversmann, 1851), *O. mulla* Staudinger, 1881 (Nymphalidae: Satyrinae)) are closely related to Siberian species. However, the most traditional opinion is that biota of the Saur and Tarbagatai have intermediate positions between biotas of the mountains of Siberia and Central Asia (Yakovlev & Guskova 2012).

The history of the study of butterflies from the Saur Mountains

One of the collectors employed by E. Eversmann was the first person who collected butterflies in the Saur Mts (or in the regions adjacent to the Saur) but now it is impossible to state who it actually was. It is known that the collector Pavel Romanov worked approximately in this region (Altai, SW Siberia) in 1840–1843. Specimens also might come from Alexander Schrenck. E. Eversmann (1843, 1851) described *Pontia leucodice* Eversmann, 1843 (Pieridae), *Hipparchia sunbecca* Eversmann, 1843 (Nymphalidae: Satyrinae), *Lycaena pheretiades* Eversmann, 1843 (Lycaenidae) and *Hipparchia fulla* Eversmann, 1851 (Nymphalidae: Satyrinae) from the area of Noor-Saisan.

The first systematic collecting of Lepidoptera in the Saur was undertaken by J. Haberhauer in 1877–1878. Materials from his collecting trip were the basis for the

works of Speyer (1879) and Staudinger (1881, 1892). Several new taxa of Papilionoidea were described from the Saur: *Pyrgus antonia* Speyer, 1879, *P. staudingeri* Speyer, 1879 (Hesperiidae) (Speyer 1879), *Erebia tyndarus* Esp. var. *sibirica* Staudinger, 1881, *Erebia pawlowskyi* Men. var. *haberhaueri* Staudinger, 1881, *Oeneis mulla* Staudinger, 1881 (Nymphalidae: Satyrinae), *Lyc.*[*aena*] *miris* Staudinger, 1881 (Lycaenidae) (Staudinger 1881) and *Coen.*[*onympha*] *iphis* Schiff. var. *iphina* Staudinger, 1892 (Nymphalidae: Satyrinae) (Staudinger 1892). Approximately at the same time the Saur was visited by the Rückbeil brothers whose specimens are still deposited in the collection of O. Staudinger and others. Later several taxa were described based on these specimens: *Parnassius apollo tarbagataica* Verity, 1911 (Papilionidae) and *Plebeius zephyrinus tarbagataiensis* Bálint, [1993] (Lycaenidae) (Verity 1911; Bálint et al. [1993]).

In the beginning of the 20th century expeditions lead by S. Tshetverikov and P. Sushkin in 1904 and A. Jacobson in 1910 collected a large amount of material. Specimens collected on these trips are still deposited in the collection of ZISP. P. Sushkin (1906, 1909) described the subspecies *Argynnis frigga annae* (Nymphalidae) and *Lycaena cyane tarbagata* (Lycaenidae); later the type series of the latter taxon was revised (along with designation of a lectotype) by P. Bogdanov (2003). In addition, members of the expedition lead by the Russian geographer V. Sapozhnikov collected in Saur in 1904; specimens collected during this trip are deposited now in the collection of the Zoological Museum of Tomsk University and they are severely damaged.

During the Soviet period the Saur was repeatedly visited by amateur entomologists – a large number of specimens is stored in private collections. Based on specimens collected by V. K. Tuzov two conspecific taxa were described – *Cupido minimus tusovi* Lukhtanov, 1994 = *Cupido tuzovi* Zhdanko, 1994 [1996] (Lycaenidae) (Lukhtanov & Lukhtanov 1994; Zhdanko 1994 [1996]). In the book by V. and A. Lukhtanov (1994), distribution maps of all taxa which inhabit the Russian and Kazakh part of the Altai are given, including species inhabiting the Saur. V. A. Lukhtanov (1990, 1999) described *Glaucopsyche argali arkhar* Lukhtanov, 1990 (Lycaenidae) and *Parnassius phoebus sauricus* Lukhtanov, 1999 (Papilionidae) based on specimens collected during his trips. S. Churkin gave some data on the distribution of Satyrinae and Lycaenidae in the Saur (along with the description of the new subspecies *Agriades glandon rubini* Churkin, 2005) (Lycaenidae) in several publications (Churkin 2005a, b, 2006). A. B. Zhdanko (2005) also provided data on the Saur in his paper on the butterfly fauna of Kazakhstan. *Euphydryas laeta calima* Bolshakov & Korb, 2012 (Nymphalidae) was described based on material from the Saur collected by P. Suschkin and A. Jacobson (Bolshakov & Korb 2012).

Authors of the present study repeatedly worked in the Saur and adjacent regions. R. Yakovlev visited this region in 2000–2003 and 2011–2012, N. Rubin collected there in 2003, 2006 and 2011. Partial results of these collecting trips have already been processed. Two new species were recorded for the Saur for the first time: *Parnassius tenedius* Eversmann, 1851 (Papilionidae) and *Leptidea morsei* (Fenton, 1881) (Pieridae) (Yakovlev 2002). Localities of *Tongeia fischeri* were shown in detail (Yakovlev 2003). Later (Yakovlev 2004, 2007, 2011), three subspecies were described – *Pieris napi*

sauron Yakovlev, 2004 (Pieridae), *Melitaea centralasiae saurica* Yakovlev, 2007, and *Euphydryas iduna jacobsoni* Yakovlev, 2011 (Nymphalidae). In the present work we present the full list of Papilionoidea taxa which are known from the Saur and adjacent territories: the Monrak and Saykan ridges, the south part of the Zaisan valley and the Chilikty valley. It is important to note that here we consider only the Kazakh part of the territory whereas the Chinese part still remains completely unknown.

List of collecting localities and dates by authors (Fig. 1)

M1 Manrak Mts, 20 km SW Zaisan, 23–24.v.2000, leg. R. V. Yakovlev;

M2 Manrak Mts, 30 km W Zaisan, 18–19.v.2001, leg. R. V. Yakovlev;

M3 Manrak Mts, near Kensai, N 47°25′, E 84°39′, 2.vi.2002, leg. R. V. Yakovlev;

M4 Manrak Mts, near Zhanaul vill., 1100 m, N 47°14′, E 84°35′, 3.vi.2002, leg. R. V. Yakovlev;

M5 E Manrak Mt. R., N 47°18′40″, E 84°36′42″, 1300 m a.s.l., 31.v., 1–4.vi.2006, 27–29.v.2011, leg. N. Rubin; 7.vi.2012, leg. R. V. Yakovlev;

M6 NE Manrak Mt. R., Saryshyi environs, 700–900 m a.s.l., 04–05.vi.2006, leg. N. Rubin;

M8 NW Manrak Mt. R., Kusty River valley, 700–800 m a.s.l., 27.v.2011, leg. N. Rubin;

S1 Saur Mts, 20 km S Zaisan, 25.v.2000, leg. R. V. Yakovlev;

S2 Saur Mts, 10 km S Charchutsu, 26.v.2000, leg. R. V. Yakovlev;

S3 Saur Mts, near Chagan-Obo, 1600–1800 m, N 47°02′, E 84°54′, 4–6.vi.2002, leg. R. V. Yakovlev;

S4 Saur Mt. R., Terekty River valley, 1200–1300 m a.s.l., 18–19.vi.2003, leg. N. Rubin;

S5 Saur Mt. R., Alatai Pass environs, 1500–1900 m a.s.l., 19–20.vi.2003, leg. N. Rubin; N 47°18′; E 85°08′, 23.vii.2011, leg. R. V. Yakovlev;

S6 Saur Mt. R., 2 km W Alatai Pass, 1800–2000 m a.s.l., 20–22.vi.2003, leg. N. Rubin;

S7 Saur Mt. R., Tas Mt. environs, 2600–2800 m a.s.l., 25.vi–03.vii.2003, leg. N. Rubin; N 47°15′, E 85°04′, 20–22.vii.2011, leg. R. V. Yakovlev;

S8 Saur Mt. R., upper Zhinishke River, 1800 m a.s.l., 01.vi.2006, leg. N. Rubin;

S9 Saur Mt. R., Small Zhemenei River valley, 1100 m a.s.l., 06–07.vi.2006, leg. N. Rubin;

S10 Saur Mt. R., Zhemenei River valley, 5 km S Zaisan, 700 m a.s.l., 08.vi.2006, 13.vi.2012, leg. N. Rubin;

S11 Saur Mt. R., upper Karagaily River, 1800 m a.s.l., 10–14.vi.2006, leg. N. Rubin;

S12 Saur Mt. R., 3 km N Ungirkora, 1300–1500 m a.s.l., 4.vi.2006, leg. N. Rubin;

S13 Saur Mt. R., Shakpaktas Mt. environs, 2500–2700 m a.s.l., 11–13.vi.2006, leg. N. Rubin;

S14 Saur Mts, 24 km S Zaisan, upper stream Bolshoi Zhemenei riv., 1650 m, N 47°14′, E 84°56′, 17–19.vii.2011, leg. R.V. Yakovlev;

S15 Saur Mts (N slopes near Kenderlik vill.), 1200 m, N 47°21′, E 85°15′, 23.vii.2011, leg. R. V. Yakovlev;

S16 Saur Mt. R., 4 km E Zaisan, 600 m a.s.l., 06.vii.2003, leg. N. Rubin;

Sa1 Saikan Mts, N 47°19′, E 85°31′, 1700 m, 7–8.vi.2002, leg. R. V. Yakovlev;

Z1 Zaisan Lake Area, Shorga River valley, 450 m a.s.l., 17.vi.2003, leg. N. Rubin;

Z2 Zaisan district, 5 km W Kensai, 500 m a.s.l., 16.vi.2006, leg. N. Rubin;

Z3 Zaisan Lake Area, Espe River valley, 6 km NE Tolagai Mt., 600 m a.s.l., 17.vi.2006, leg. N. Rubin;

Z4 Zaisan Lake Area, 15 km E Karasu, 600 m a.s.l., N 47°47′96″, E 083°39′81″, 26, 30.v.2011, leg. N. Rubin;

Fig. 1. Map of the Saur Mountains. **a**, Saur in the map of Central Asia; **b**, map with points of collecting localities.

Z5 Zaisan Lake Area, 6 km W Zaisan, 600 m a.s.l., 6.vii.2003, leg. N. Rubin;

Z6 Zaisan Lake Area, Bazar River valley, 17.vi.2003, leg. N. Rubin;

Z7 Zaisan Lake Area, Karabulak environs, 17.vi.2003, leg. N. Rubin;

Z8 Zaisan Lake Area, 7 km NE Zaisan, 500 m a.s.l., 30.v.2006, leg. N. Rubin;

Ch1 Chilikty Depression, 5 km NW Chilikty, 1100 m a.s.l., 09.vi.2006, leg. N. Rubin;

Ch2 Chilikty Depression, Chagan-Obo River valley, 1600 m a.s.l., 12.vi.2006, leg. N. Rubin.

Annotated list of species

HESPERIIDAE

***Erynnis tages* (Linnaeus, 1758)**

M1, M2, M4, M5, M8, S1, S2, S8, S9, S10, Sa1. Everywhere. Steppe slopes of gullies in foothills, forb meadows in gorges at 500–1500 m.

***Carcharodus alceae* (Esper, [1780])**

M1, Sa1. Locally at 500–1200 m.

***Syrichtus cribrellum* (Eversmann, 1841)**

M5, M9, S1. Locally abundant at 100–1400 m.

***Syrichtus tessellum* (Hübner, [1803])**

S1. Local, rare.

***Syrichtus antonia* (Speyer, 1879)**

M1, M2, M4, M6, M8, S10, Sa1. Common. Stony steppe slopes of foothills of north macro-slopes of the Saur and Manrak at 500–1500 m.

***Syrichtus staudingeri* (Speyer, 1879)**

M1, M8. Local and scanty. Just a few specimens were collected in the north-eastern foothill part of the Manrak. Stony steppes and semideserts in places with very scarce vegetation at 700–1000 m.

***Spialia orbifer* (Hübner, [1823])**

M3, S1, S2, S4, S9. Single specimens on steppe slopes of foothills and in mountain valleys at 500–1400 m.

***Pyrgus malvae* (Linnaeus, 1758)**

M4, S2, S4, S9. Found almost everywhere but only single specimens. Mesophytic sites in river valleys and stream beds at 1000–1800 m.

***Pyrgus alveus* (Hübner, 1803)**

S5. Single specimens in tallgrass meadows of the Terekty gorge north of the Alatai pass at 1500–1800 m.

***Pyrgus serratulae* (Rambur, 1839)**

ssp. *uralensis* Warren, 1926

M1, M2, M5, S4, S5, S8, S11, Sa1, Ch2. Everywhere; characteristic species for these ridges. Forb meadows on mountain slopes at 1000–1900 m.

Carterocephalus silvicola **(Meigen, 1828)**

S2, S9. Rather common on the northern macro-slope of the Saur in wet meadows along rivers and streams in the lowlands at 800–1100 m.

Carterocephalus palaemon **(Pallas, 1771)**

S14. A single very worn specimen was found in a meadow in a stream valley.

Thymelicus lineola **(Ochsenheimer, 1808)**

S14, S15. Rare. Steppe slopes.

Ochlodes sylvanus **(Esper, [1778])**

S9. Common on the northern macro-slope of the Saur in wet meadows along rivers and streams in the lowlands at 800–1100 m.

Hesperia comma **(Linnaeus, 1758)**

S5, S14. Rather rare. Steppe slopes.

PAPILIONIDAE

Iphiclides podalirius **(Linnaeus, 1758)**

M1, M8, M4, S1, S2, S4. Common on clearings along rivers and streams in foothills and the lower mountain zone at 500–1200 m.

Papilio machaon **Linnaeus, 1758**

M2, M3, M4, M5, M8, S2, S3, S11, S12. Common in the Manrak and Saur at 600–2500 m.

Parnassius apollonius **(Eversmann, 1847)**

M8, Z4. Rather widely distributed in foothills and in the lower mountain zone of the eastern part of the Monrak but very local. Localities are very different, varying from nearly flat steppe in the valley of the Shorga River to almost upright rocky slopes of the Kusty River canyon. Number of individuals in habitats is small as well as its host plant (sometimes only one plant per 100 m^2).

Parnassius apollo **(Linnaeus, 1758)** **Figs 7, 8**

ssp. *tarbagataicus* Verity, 1911

S4, S14. Steppe slopes covered by *Caragana* at 1200–1400 m. Local but numerous in habitats.

***Parnassius phoebus* (Fabricius, 1793)** **Figs 9–12**

ssp. *sauricus* Lukhtanov, 1999

S7, S11. Numerous in alpine meadows and on stony slopes mostly at 2500–2900 m. It is interesting that one male was found on the southern macro-slope on 10 June at 1800 m. Specimens are very variable in habitus, colour pattern varies from completely developed red spots (but the second spot on hind wing small and without red center) to completely reduced (5% of individuals).

***Parnassius ariadne* (Lederer, 1853)** **Fig. 60**

ssp. *clarus* Bryk & Eisner, 1933

M1, M2, M3, M4, M5, S1, S2, S5, S9, S11, Sa1. Everywhere in scrublands, both tall-grass and steppe meadows on mountain slopes at 1000–1400 m. More common in the Manrak where rather humid localities with *Corydalis* (Fumariaceae) are more abundant. Found also on the southern slope of the Saur but in fewer individuals and at higher altitude – 1800–1900 m. Habitats of *Corydalis* are limited as narrow band along the stream (Karagaily River).

***Parnassius tenedius* Eversmann, 1851** **Figs 13, 14**

Extremely rare. Only two specimens are known from the Saur: ♂, Saur, Temir-Su River, 1911 (collection of Tomsk University) and ♀, Saur, 20 km E Przhevalskoe, 24.06.2002, leg. S. V. Ovchinnikova (collection of Roman Yakovlev, Barnaul).

PIERIDAE

***Leptidea sinapis* (Linnaeus, 1758)**

M5, S3, S9. Scrubland slopes in foothills and lower mountain zone at 1000–1300 m. The material was confirmed based on the genitalia structure.

***Leptidea morsei* (Fenton, 1881)**

S3. Very rare. Moist meadows.

***Aporia crataegi* (Linnaeus, 1758)**

M5, S2, S3, S9, S10, Sa1, Ch2. Everywhere. From scrubland slopes of gullies in steppes and foothills to middle mountain zone at 500–1400 m. Often appears in large numbers. N. Rubin observed a migration of this species along the Zhemenei River in 2006 as a solid band (width 10 m) for 5 hours.

***Metaporia leucodice* (Eversmann, 1843)**

S4, S9. Common on the northern macro-slope on scrubland slopes of gullies in foothills and lower mountain zone at 500–1000 m.

***Anthocharis cardamines* (Linnaeus, 1758)**

Subspecific status is unclear, close to Siberian subspecies *progressa* (Sovinsky, 1905). M8, S3, S5. Frequent along rivers and streams in forest mountain zone at 700–1500 m.

***Euchloe creusa* (Doubleday, 1847)**

ssp. *emiorientalis* Verity, 1911

M2, S3, Ch2. Rare, several specimens were found on steppe slopes of the Saur on the right bank of Chilikty valley and in the Eastern Manrak.

***Euchloe ausonia* (Hübner, [1803])**

M2. Very rare. Steppe mountain summits. Probably flies earlier (in the beginning of May).

***Pontia edusa* (Fabricius, 1777)**

Everywhere except high altitudes (up to 2200 m).

***Pontia callidice* (Hübner, [1803])**

S7, S11. Frequent in alpine meadows and in stony mountain tundras at 2000–2700 m. Males display well-developed hilltoping behaviour.

***Pontia chloridice* (Hübner, [1813])**

M1, S9. Rare, several specimens were found on steppe slopes of the Small Zhemenei valley and on the Manrak ridge.

***Pieris brassicae* (Linnaeus, 1758)**

Z4. Common species of foothills at 500–1000 m. More frequent in anthropogenic habitats.

***Pieris rapae* (Linnaeus, 1758)**

ssp. *debilis* (Alpheraky, 1889)

Everywhere, from steppes and semideserts of the southern shore of Zaisan lake and Chilikty depression to steppe slopes of foothills and lower mountain zone in all ridges of the investigated territory at 500–1600 m.

***Pieris euorientis* (Verity, 1908)**

ssp. *sauron* Yakovlev, 2004

M4, S3, S5, S8, S11. Common species in the Saur in upper forest zone and in subalpine meadows at 1500–2300 m. On the northern macro-slope it inhabits only the forest zone along the Terekty River; it was not found on the Alatai pass and southwards. On the southern macro-slope very common on slopes in mountain valleys at 1200–2500. Single specimens were found on the Manrak. Fly period: end of May–June.

***Colias erate* (Esper, [1805])**

M1, M4, M8, Z3, S1, Ch2. Common species in steppes and on steppe slopes of foothills and upper mountain zone at 500–1300 m. Common in anthropogenic landscapes.

***Colias hyale* (Linnaeus, 1758)**

M4, M8, S4. Frequent on steppe slopes of foothills and upper mountain zone at 700–1300 m.

***Colias thisoa* Ménétries, 1832**

S5, S6, Ch2. Local but rather frequent in its habitats. Meadows of upper forest zone and subalpic meadows at 1700–2200 m.

***Gonepteryx rhamni* (Linnaeus, 1758)**

M1, M4. Bushy meadows in river valleys and stream beds.

NYMPHALIDAE

***Lasiommata maera* (Linnaeus, 1758)**

M1, M5, S2, S4, S5. Common. Bushy slopes of foothills and lower mountain zone, more frequent close to rocks at 1000–1800 m.

***Lasiommata petropolitana* (Fabricius, 1787)**

M4, M5, S2, S3, S6, S8, S9, S11. Common species. Slopes of gullies in foothills, more frequent in forest zone at 1300–2000 m.

***Melanargia russiae* (Esper, [1783])**

S4, S7, S10, S14, S15, Z2, Z3. Common, steppes of Zaisan depression, foothills and steppe meadows in mountains. Single specimens were observed in meadows up to 2400 m.

***Coenonympha tullia* (Müller, 1764)**

ssp. *subcaeca* (Heyne, 1894)

S7. Found at high altitudes in the Saur. Local, found in swampy alpine meadows and mountain stony tundras, sometimes at just melted snowfields at 2600–2800 m.

***Coenonympha glycerion* (Borkhausen, 1788)** **Figs 27, 28**

ssp. *iphina* Staudinger, 1892

S4, S9, S10, S14. Local and scanty. Moderately wet meadows in depressions between mountains on the northern macro-slope of the Saur at 500–1300 m.

***Coenonympha amaryllis* (Stoll, 1782)**
S4, S10. Common species on steppe slopes of foothills and in upper mountain zone at 500–1300 m.

***Coenonympha pamphilus* (Linnaeus, 1758)**
M4, M8, S2, S10, Ch2. Common on slopes of gullies in foothills and steppe meadows in middle mountain zone at 600–1600 m.

***Coenonympha oedippus* (Fabricius, 1787)**
S4. Single specimens were found in wet meadows in the valley of the Terekty River at 1200 m.

***Coenonympha sunbecca* (Eversmann, 1843)**
Modern records from the Saur are absent. Described from "... in campis aridis ad lacum Noor-Saisan", probably can be found in the Chinese part of the range.

***Triphysa phryne* (Pallas, 1771)**
M1, M8, S1, S8. Rare. Several specimens were found on steppe slopes of the Eastern Saur and Manrak at 700–1800 m.

***Hyponephele lycaon* (Rottemburg, 1775)**
ssp. *catamelas* (Staudinger, 1886)
S4, S14, S15. Frequent. Steppe slopes in foothills and lower mountain zone, mostly near rock exposures at 700–1300 m.

***Hyponephele lupina* (Costa, 1836)**
ssp. *intermedia* (Staudinger, 1886)
S15, Z2, Z3. Common in steppes and foothills. Stony and clay slopes of gullies at 600–1000 m.

***Hyponephele dysdora* (Lederer, 1869)**
Stated for Saur by Lukhtanov & Lukhtanov (1994: fig. 137). Not found by us.

***Hyponephele interposita* (Erschoff, 1874)**
S15, Z2. Numerous in foothill steppes and semi-deserts. Clay slopes of gullies and droves at 600–1000 m.

***Hyponephele huebneri* Koçak, 1980**
ssp. *ambialtaica* Kosterin, 2002
Stated for the southern part of the Zaysan valley (Lukhtanov & Lukhtanov 1994: fig. 129). Not found by us.

***Hyponephele naricina* (Staudinger, 1870)**

Z3. Found in large numbers in foothill stony semideserts and clay hills of the Eastern Manrak at 600–800 m.

***Hyponephele cadusina* (Staudinger, 1881)**

Stated for the Saur (Lukhtanov & Lukhtanov 1994: fig. 122). Not found by us.

***Erebia haberhaueri* Staudinger, 1881** **Figs 19, 20**

S5. Moreover, known by the specimens collected by P. Suschkin, A. Jacobson and K. Kolesnichenko from the following localities: S. slope of Saur, Tik-Bulak spring; upper stream of Ujdene River; Mai-Chat loc.; S from Kyzyl-Kiya vill. (Churkin 2005a). Meadows in forest zone at 2200–2500 m.

***Erebia sibirica* Staudinger, 1881 stat. rev.** **Figs 21–26, 29**

S7. Found in large numbers in alpine and *Carex* meadows at 2500–2800 m.

Systematic notes. The taxon *sibirica* Staudinger, 1881 was described for populations from the Saur and Tarbagatai "... auf dem Tarbagatai in großen Stücken gefangen ..." (Staudinger 1881: 270) in primary combination *Erebia Tyndarus* Esp. *Sibirica.* Later Warren (1936) suggested the combination *Erebia callias sibirica.* Beside this combination Warren treated all Siberian taxa from the *E. tyndarus* (*altajana* Staudinger, 1901 (Altai) and *simulata* Warren, 1933 (E. Sayan)) group as subspecies of *Erebia callias* Edwards, 1871, described from "Mountains Colorado [Aidaho, USA]". From this moment all records of this group for Kazakh taxa were mentioned as subspecies of *E. callias*. Also several subspecies were described: *Erebia callias tscherskiensis* Dubatolov, 1992 (E. Siberia, Yakutia, Cherskyi Mts, 185 km NW ust'-Nera) and *Erebia callias chastilovi* Churkin, 2003 (Mongolian Altai, 30 km S Biger). P. Bogdanov (2008) was the first person who suggested treating *sibirica* Staudinger, 1881 as a bona species, proved in his opinion by important differences in the arming of valvae. In the same work he described *Erebia churkini* Bogdanov, 2008 from Polar Ural. Later (Yakovlev 2012), the specific status of *E. chastilovi* was confirmed and two taxa from Mongolia were described – *E. chastilovi nomada* Yakovlev, 2012 and *E. przhevalskii* Yakovlev, 2012. This group of taxa requires a major revision.

For verification of P. Bogdanov's opinion we performed an investigation of habitus characters of a large number of males and females. We also carried out a study of genitalia of 6♂♂ and 2♀♀ of *E. sibirica* from "Saur Mts., Tas Mt., 2350–2600 m, 47°15′N; 85°04′E, 20–22.vii.2011, leg. R.V. Yakovlev". It was found that external characters are very unreliable; only the less developed brown field on the forewing of both sexes and the specific greyish colouration of the hindwing underside in males can be mentioned as differentiating characters. However, the comparison of genital characters shows significant differences from all Asian and American taxa of the group. Description of genitalia is presented herein.

Male genitalia. Uncus moderately long, slightly curved ventrally, tegumen stout, subunci long, thick, falcate. Valvae moderately wide, smoothly curved in middle third, caudal third on costal edge has specific arming which consists of a massive sharp caudally directed tooth and three small teeth, gradually shortening towards the caudal direction. Arming of valvae slightly varies, it is expressed in teeth length and certain skewness. Phallus short and thick, with obtuse apex, vesica without cornuti. Juxta saddle-shaped, well sclerotised. Saccus medium-sized, directed backwards. Genitalia differ well from *E. callias callias*, *E. callias altajana*, *E. callias simulata*, *E. callias tscherskiensis*, *E. chastilovi* and *E. chastilovi nomada* which have the costal edge of valvae with smaller area of arming. The closest species are *E. przhevalskii* and *E. churkini* which have significant differences: very thin caudal end of valva (4–5 times thinner than middle part of valva) in *E. przhevalskii* and double the largest (proximal) tooth on costal edge of valva, valva thinner and somewhat straight in *E. churkini.*
Female genitalia. With U-shaped antevaginal plate placed on comparatively long basal procession. Bursa with paired band-like signum (bands of sclerotisation very close to each other).

***Proterebia afra* (Fabricius, 1787)**

M4, Sa1. Multiple specimens. Probably peak of flight is in the end of April until the beginning of May. Steppes in foothills and low mountain zone up to 1500 m.

***Arethusana arethusa* ([Denis & Schiffermüller], [1775])**

S14. Steppe slopes, rare.

***Oeneis tarpeia* (Pallas, 1771)**

M1, M2, M4, M5, S1, S2, S4, S8, S9, S11, Sa1. Frequent on steppe slopes in middle mountain zone and in alpine meadows of the Saur and Manrak. More common at 1000–1500 m, but in the area of the Shakpartas Mt. we observed single specimens at 2700 m. Common on the Saikan ridge.

***Oeneis mulla* Staudinger, 1881** **Figs 17, 18**

M5, S1, S12. Local. Found in the Saur, Saikan and in the eastern part of the Manrak (Lukhtanov 1984; Lukhtanov & Eitchberger 2000). Inhabits abrupt steppe mountain slopes at 600–1600 m. Males generally prefer rocks on crests of ridges. Defence of individual territory well developed, and they chase not only conspecific individuals but also larger species such as *Papilio machaon* and *Aglais urticae*. Females hide in grass near foots of rocks and on open slopes and prefer not to fly. Peak of flight is in the first half of the day, the rest of the time butterflies spend in niches of vertical walls and in splits of rocks.

***Oeneis fulla* (Eversmann, 1851)** **Figs 15, 16**

S7, S8, S13. Common in mountain tundras and in alpine meadows of the Saur at 2000–2800 m. Defence of individual territory by males is well developed as in the

previous species, but specimens of *O. fulla* avoid large rock exposures by inhabiting flatter slopes and tops, and use large stones as look-out-stations. Sitting on the ground, the butterflies immediately expose the maximal area of their wings to the sunlight.

***Hipparchia autonoe* (Esper, 1783)**

S4, S5, S14, S15, Z3. Numerous in foothill steppes and on steppe slopes at middle altitudes at 1500 m. Usually adhere to clay or stony slopes of gullies and rocky areas in mountains.

***Minois dryas* (Scopoli, 1763)**

S14. Rare, found in forest zone.

***Satyrus ferula* (Fabricius, 1793)**

ssp. *altaica* Grum-Grshimailo, 1893

S15. Common on steppe slopes.

***Pseudochazara hippolyte* (Esper, [1784])**

S4, S15, Z2, Z3. Frequent on stony steppe slopes at 500–1500 m. Males prefer tops of hills and places near crests in mountains.

***Chazara briseis* (Linnaeus 1764)**

ssp. *meridionalis* (Staudinger, 1886)

S14, S15, Z5. Frequent. Stony semideserts and steppes, slopes of gullies, dry gorges in mountains at 500–1500 m.

***Chazara enervata* (Alpheraky, 1881)**

S15, Z2. Common, inhabits stony and clay foothill steppes and semideserts and rocky steppe slopes and gorges in mountains at 500–1300 m.

***Chazara heydenreichi* (Lederer, 1853)**

S15. Habitats similar to the previous species.

***Limenitis helmanni* Kindermann in Lederer, 1853**

Stated for the Saur (Lukhtanov & Lukhtanov 1994: fig. 165). Not found by us.

***Limenitis sidyi* Kindermann in Lederer, 1853**

Stated for the Saur (Lukhtanov & Lukhtanov 1994: fig. 165). Not found by us.

***Limenitis populi* (Linnaeus, 1758)**

S4, S14. Extremely rare, river valleys.

***Neptis rivularis* (Scopoli, 1763)**

Almost everywhere except at high altitudes. Inhabits shrubby slopes of gullies in foothill steppes, river and stream valleys in mountains at 500–1500 m.

***Polygonia c-album* (Linnaeus, 1758)**

M1, M3, S1, S3, S9, S14. Almost everywhere but sparse. Found in different habitats except deserts and high altitudes. Frequent in anthropogenic habitats.

***Polygonia interposita* (Staudinger, 1881)**

S9. Sparse, only few specimens were collected in forest zone in the valley of the Small Zhemenei at 1200–1400 m.

***Nymphalis antiopa* (Linnaeus, 1758)**

S14. Rare. Forest zone.

***Nymphalis vaualbum* ([Denis & Schiffermüller], 1775)**

S14. Common in forest zone.

***Nymphalis xanthomelas* (Esper, [1781])**

S14. Common in forest zone.

***Vanessa cardui* (Linnaeus, 1758)**

Everywhere in steppes and semideserts of foothills. Migrating individuals inhabit all altitudes up to the nival zone.

***Aglais urticae* (Linnaeus, 1758)**

Common in forest zone, up to alpine meadows at 1000–2700 m in alpine zone of mountain steppes.

***Inachis io* (Linnaeus, 1758)**

S14. Rare. Forest zone.

***Araschnia levana* (Linnaeus, 1758)** **Figs 30, 31**

S9. Found only in one place – brake near small stream (inflow of the Small Zhemenei) but in rather large numbers. Recorded here for the Saur for the first time.

***Argynnis pandora* ([Denis & Schiffermüller], 1775)**

M1, S1, S5, S14. Forest zone at 1500–1700 m.

***Argynnis niobe* (Linnaeus, 1758)**

S14. Rare. Forest zone.

Argynnis adippe **([Denis & Schiffermüller], 1775)**

S14. Rare. Forest zone.

Argynnis aglaja **(Linnaeus, 1758)**

S4, S7, S14, S5. Common in forest zone. Frequently rises up to 2500 m.

Brenthis ino **(Rottemburg, 1775)**

S4, S14. Wet meadows at 1200–1500 m.

Brenthis daphne **(Bergsträsser, 1780)**

Stated for the Saur (Tuzov 2003). Not found by us.

Brenthis hecate **([Denis & Schiffermüller], 1775)**

Stated for the Saur (Tuzov 2003). Not found by us.

Issoria lathonia **(Linnaeus, 1758)**

Everywhere in all zones except deserts.

Clossiana selenis **(Eversmann, 1837)** **Fig. 39**

ssp. *sibirica* (Erschoff, 1870)

S11, S14. Extremely rare. Recorded for the Saur for the first time.

Clossiana euphrosyne **(Linnaeus, 1758)**

S9, S14. Wet meadows in river and stream valleys in forest zone at 1500–1700 m.

Clossiana frigga **(Thunberg, 1791)** **Figs 36–38**

ssp. *annae* (Sushkin, 1906)

S7. Found by us only in cirques near the Tas mountain, but judging by its frequency it should inhabit all highlands of the Saur. It may be local but probably can be found in large numbers in suitable habitats. More frequent in boggy meadows but also found in stony tundras and even crests of ridges (but with smoothed relief). We found an interesting peculiarity: both males and females appear almost at the same time but probably the flight period is short. The first mass flight was at the bottom of the cirque but on the next day fresh specimens were only found at 100 m higher altitude (just a few specimens were at the bottom). For a few days butterflies were observed just on crests between cirques and there were no specimens lower down, thus total flight period is about a week.

Clossiana freija **(Thunberg, 1791)**

ssp. *pallida* (Elwes, 1899)

S7, S13. Multiple specimens, it probably inhabits all parts of the plateau of the Saur. Found in stony alpine meadows and mountain tundras at 2500–2800 m. One of the first species which appears in the first decade of June and flies until the end of June.

***Clossiana dia* (Linnaeus, 1767)**

ssp. *alpina* (Elwes, 1899)

S3, S6. Infrequent, just a few specimens were found in the forest zone at 1500–1700 m.

***Boloria altaica* (Grum-Grshimailo, 1887)**

S7. Abundant in wet alpine meadows and mountain tundras over 2500 m.

***Euphydryas aurinia* (Rottemburg, 1775)** **Figs 32, 33, 61**

ssp. *calima* Bolshakov & Korb, 2012

Common species from foothills to alpine meadows through the region at 500–2000 m.

***Euphydryas maturna* (Linnaeus, 1758)**

ssp. *staudingeri* (Wnukowsky, 1929)

S9. Bushy clearings in valleys of small rivers and streams in forest zone at 1000–1400 m.

***Euphydryas iduna* (Dalman, 1816)** **Fig. 34**

ssp. *jacobsoni* Yakovlev, 2011

S7, S13. Very rare, just 3 specimens were collected in mountain tundras at 2500–2600 m. The subspecies was described based on a large series with the following labels: 'E. Kazakhstan, Saur Mts., upper stream of B. Dzhemenej River, 2150 m, 13–15.vi.1910, A. Jakobson'.

***Melitaea didyma* (Esper, [1777])**

ssp. *neera* Fischer de Waldheim, 1840.

M5, M6, M8, S4, S9, S10, Sa1. Rather common in desert foothills and on dry slopes in the lowland of the northern macro-slope of the Saur, Manrak and Saikan at 500–1300 m.

***Melitaea ala* Staudinger, 1892** **Fig. 35**

S4. Very rare and local, just 2 specimens were collected in steppe dry meadow in the Terekty valley at 1300 m. Reported for Saur by Kolesnichenko (1999).

***Melitaea trivia* ([Denis & Schiffermüller], 1775)**

M1, M8, M4. Rather rare and local, inhabits steppe mountain slopes in lower and middle mountain zone at 1000–1500 m.

***Melitaea phoebe* ([Denis & Schiffermüller], 1775)**

M5, S4, S9, S10, S14. Frequent on slopes of gullies in foothills and in lower and middle mountain zone at 1000–1500 m.

***Melitaea cinxia* (Linnaeus, 1758)**

M2, M5, S1, S2, S4, S6, S9, S12, Sa1. Common species of dry meadows and steppe

mountain slopes in lower and middle mountain zone at 1000–1500 m. In contrast to European populations dark-coloured females rather common.

***Melitaea arduinna* (Esper, [1784])**

M1, M2, M3, M5, M8, S1, S2, S9, S11, S12, Sa1. Frequent on steppe mountain slopes in lower mountain zone at 700–1300 m.

***Melitaea athene* Staudinger, 1881**

M2, M3, M8. Local but widely distributed on the northern slopes of the Manrak, Saur and Saikan in foothills at 500–800 m. Like the others species of the group it inhabits dry stony slopes, both abrupt and flat, and prefers scree slopes (Tuzov 2000).

***Mellicta athalia* (Rottemburg, 1775)**

ssp. *reticulata* Higgins, 1955

M5, S4, S6, S9, S10, S14. Frequent in meadows of the lowland and in forest zone of mountains at 1200–1500 m.

***Mellicta britomartis* (Assmann, 1847)**

M5, S4, S9. Local and scanty in moderately wet meadows in lower mountain zone at 1200–1400 m.

***Mellicta menetriesi* (Caradja, 1895)** **Figs 40, 41**

ssp. *saurica* Yakovlev, 2007

M5, S8, S9, S12, Sa1. Common, dry and moderately wet, often rocky, slopes of mountains at 1200–1700 m.

LYCAENIDAE

***Neolycaena rhymnus* (Eversmann, 1832)**

M1, M2, Sa1. Steppe slopes with bushes.

***Neolycaena submontana* Zhdanko, 1996** **Figs 45, 46, 65**

ssp. *saurica* Zhdanko, 1998

M1, M2, M3, M6, S1, S2, S10, Sa1, Z2. Abundant on steppe and desert stony slopes in foothills, prefers bushy areas covered by *Caragana* (Fabaceae) at 500–1000 m.

***Neolycaena tengstroemi* (Erschoff, 1874)**

ssp. *balchashensis* Zhdanko, 1998

Z1, Z6, Z7. Frequent in semideserts and dry steppes of the shore of Zaisan lake at 400–600 m.

***Callophrys rubi* (Linnaeus, 1758)**

ssp. *sibirica* Heyne, [1895]

M5, S1, S2, S8, S11, S12. Frequent, inhabits brakes in valleys and mountain slopes in forest zone at 1200–1500 m.

***Callophrys suaveola* (Staudinger, 1881)**

M2, M5. Very rare, single specimens occur on mountain slopes, usually on bushes of *Spiraea* at 1200–1500 m. Localities were published by Krupitsky & Yakovlev (2012).

***Lycaena helle* ([Denis & Schiffermüller], 1775)**

ssp. *phintonis* Fruhstorfer, 1910

S3, S5, S8, S11. Common species. Inhabits moist meadows in river and stream valleys, subalpine meadows and mountain slopes where scanty in first half of June at 1500–2500 m.

***Lycaena phlaeas* (Linnaeus, 1761)**

S11, S14. Rare species, meadows.

***Lycaena hippothoe* (Linnaeus, 1761)**

S14. Very rare, meadows.

***Lycaena dispar* (Haworth, 1803)**

ssp. *rutilus* (Werneburg, 1864)

S14. Very rare, meadows.

***Lycaena alciphron* (Rottemburg, 1775)**

S14. Very rare, meadows.

***Lycaena thersamon* (Esper, [1784])**

M2, M4, S1, S16, Sa1. Locally. On the territory in question it inhabits dry steppes in foothills and steppe mountain slopes at 500–1300 m.

***Athamanthia dimorpha* (Staudinger, 1881)** **Figs 50, 51, 62**

ssp. *saisana* Lukhtanov, 2000

Z3. Local but numerous in its habitats. Inhabits both flat stony steppes and dry mountain slopes with slide-rocks and rock exposures in foothills at 700–1000 m.

***Cupido tusovi* Lukhtanov, 1994** **Figs 58, 59, 63**

Almost everywhere. Endemic to the Saur, common both on steppe slopes of depressions between mountains and in moderately wet meadows in forest zone and subalpine

meadows at 800–2400 m. Interesting peculiarity is that males from the lowland have more intensive blue suffusion whereas butterflies from subalpine zone lack the suffusion and resemble *C. minimus*.

***Cupido osiris* (Meigen, 1829)**

Almost everywhere. Common on steppe slopes of foothills and in forest zone at 500–1700 m.

***Cupido prosecusa* (Erschoff, 1874)**

Z1, Z8. Scanty, inhabits brakes in lower course of river valleys and shores of Zaisan lake.

***Tongeia fischeri* (Eversmann, 1843)**

Almost everywhere. Common in stony areas on steppe slopes of foothills and rock exposures in forest zone of mountains at 500–1900 m.

***Celastrina argiolus* (Linnaeus, 1758)**

M4, M5. Common but scanty, inhabits different biotopes, prefers brakes in river and stream valleys at 500–2000 m.

***Scolitantides orion* (Pallas, 1771)**

ssp. *johanseni* (Wnukowsky, 1934)

Almost everywhere. Inhabits steppe biotopes both in foothills and mountains, prefers stony areas at 500–2000 m.

***Pseudophilotes vicrama* (Moore, 1865)**

ssp. *schiffermuelleri* (Hemming, 1929)

M5, M8, S4, S10, S14, Sa1. Rather common but scanty. Inhabits dry stony slopes of gullies in foothills and lower mountain zone at 400–600 m.

***Praephilotes anthracias* (Christoph, 1877)**

Recorded for the Zaisan depression (Lukhtanov & Lukhtanov 1994). Not found by us.

***Glaucopsyhe alexis* (Poda, 1761)**

M5, S2, S3, S4, S9, S11, S12, S14, Sa1, Ch2. Common species. Inhabits meadows of different types in foothills and forest zone of mountains at 1000–2000 m.

***Glaucopsyche argali* Elwes, 1899**

ssp. *arkhar* Lukhtanov, 1990

Extremely rare and local. Known from several localities on the northern slopes of the Saur and Manrak where it inhabits stony steppe slopes of lower mountain zone at

1000–1500 m. Described from the following localities: 20 km S Zaisan (locus typicus); Manrak, Karataltaldy loc. R. Yakovlev collected 1♀ in the type locality on 25.v.2000.

***Phengaris arion* (Linnaeus, 1758)**

M5, S2, S3, S4, S9, S10, S12. Scanty, found on steppe slopes in foothills and in meadows in forest zone at 500–1500 m.

***Phengaris alcon* ([Denis & Schiffermüller], 1775)** **Figs 52, 53**

S4 and 5 km N Alatai Pass, 1500–1600 m a.s.l., 19.vi.2003. First record for the Saur. Extremely rare.

***Plebejus argus* (Linnaeus, 1758)**

ssp. *wolgensis* (Forster, 1936)

S3 and everywhere in Zaisan depression. Common, sometimes numerous (SW part of Zaisan depression), inhabits steppes and meadows of different types in foothills at 500–1200 m.

***Plebejus maracandicus* (Erschoff, 1874)**

ssp. *planorum* (Alpheraky, 1881)

Almost everywhere. Common, inhabits different biotopes from semideserts to moderately wet subalpine meadows in forest zone of mountains at 500–1900 m.

***Plebejus idas* (Linnaeus, 1761)** **Fig. 57**

S10. Very rare. Only one male on a stony slope.

***Plebejus lepidus* Zhdanko, 2000** **Figs 55, 56, 64**

Z1, Z6, Z7. Very local but rather frequent in its habitats. Bushy areas of semideserts and dry steppes in the southern part of Zaisan depression at 500–750 m. Usually adheres to bushes of its host plant *Elaeagnus rhamnoides* (L.) A. Nelson (Elaeagnaceae).

***Plebejides pylaon* (Fischer von Waldheim, 1832)**

M1, M2, M3, S1, S2, S8, S11, Sa1. Local and scanty, found by us on the southern macro-slope of the Saur in forb subalpine meadows at 1800–2000 m.

***Plebejides zephyrinus* (Christoph, 1884)**

ssp. *tarbagataiensis* Bálint, 1992

Reliably known only from the vicinity of Kenderlik Village.

***Eumedonia eumedon* (Esper, [1780])**

M5, M8, S3, S9, S14. Local and scanty. Found mostly on grass meadows along river valleys in mountains at 1000–1400 m.

***Aricia allous* (Geyer, 1837)**

ssp. *strandi* (Obraztsov, 1935)

S11, S14, Z8, Ch2. Local and scanty. Found in different biotopes but mostly on grass meadows along river valleys and stream beds in mountains at 1500–2000 m. One specimen was found in brakes in dry bed of the Zhemenei River N Zaisan at 500 m.

***Aricia agestis* ([Denis & Schiffermüller], 1775)**

Stated for the Saur (Lukhtanov & Lukhtanov 1994). Not found by us.

***Cyaniris semiargus* (Rottemburg, 1775)**

ssp. *altaianus* Tutt, 1909

M5, S3, S4, S12, S14. Common, inhabits steppe slopes of foothills in depressions between mountains and different meadows in forest zone at 1000–1400 m.

***Alpherakya sarta* (Alpheraky, 1881)**

Stated for the Saur (Lukhtanov & Lukhtanov 1994). Not found by us. In the Saur it should inhabit semidesert biotopes in northern foothills.

***Rueckbeilia fergana* (Staudinger, 1881)**

M8. Rare and local. Just one specimen was found in the Manrak on steppe brake slope of gully at 800 m.

***Rimisia miris* (Staudinger, 1881)**

S10, Sa1. Inhabits stony slopes of gullies and dry stream beds in steppes and semideserts at 500–1000 m.

***Glabroculus cyane* (Eversmann, 1837)**

ssp. *tarbagatus* (Suschkin, 1909)

M2, M3, M4, M6, S1, S2. Local and rare, found in stony dry steppe on gullies.

***Albulina orbitula* (de Prunner, 1798)**

ssp. *sajana* (Heyne, [1895])

S5, S11. Frequent. Inhabits moderately wet mountain meadows upper forest edge at 1900–2300 m.

***Agriades glandon* (de Prunner, 1798)** **Figs 47, 48**

ssp. *rubini* Churkin, 2005

S7, S11. Rare and local. Inhabits rock exposures and rubbly slide-rocks at 2200–2500. Found in both localities only on exposures of red granite.

***Agriades pheretiades* (Eversmann, 1843)**

Described from "Noor-Zaisan". The series with label 'Sar-Tologoi, 7.07.1904' collect-

ed by P. Suschkin is deposited in ZISP. It is unknown what part of the Sar-Tolgoi pass was explored by P. Suschkin, probably he collected on the territory of China.

***Polyommatus eros* (Ochsenheimer, [1808])**

ssp. *kaabaki* Korb, 2000

M5, S3, S4, S11, S14, S5. Local but frequent in its habitats, inhabits stony steppe meadows on slopes of lower mountain zone, river and stream valleys in forest zone and above forest zone at 1200–2000 m.

***Polyommatus icadius* (Groum-Grshimaïlo, 1890)** **Figs 42–44**

S4, S14. Very local at the first site, was found only in one locality on steppe stony slope of southern exposure. Population was confined to a small area of 50 × 100 m. Specimens adhered to small bushes of host plant which grew in very small numbers among rubbly slide-rocks on slope with inclination of about 30°. In the second locality it was more common along a forest road. Subspecific status is unknown.

***Polyommatus icarus* (Rottemburg, 1775)**

Almost everywhere. Frequent, different meadows in river valleys of the lowland and forest zone at 1200–2000 m.

***Polyommatus amandus* (Schneider, 1792)**

M1, M2, M3, M5, S1, S2, S3, S4, S5, S9, Sa1. Frequent, different meadows in river valleys of the lowland and forest zone at 1200–2000 m.

***Polyommatus thersites* (Cantener, [1835])**

ssp. *orientis* (Sheljuzko, 1928)

Everywhere in steppe meadows in river valleys and on mountain slopes in forest zone at 1000–2000 m.

***Polyommatus damon* ([Denis & Schiffermüller], 1775)** **Fig. 54**

ssp. *mongolensis* (Koçak, 1980)

S14. Common in meadows and on forest roads.

***Polyommatus damone* (Eversmann, 1841)**

ssp. *sibirica* (Staudinger, 1899)

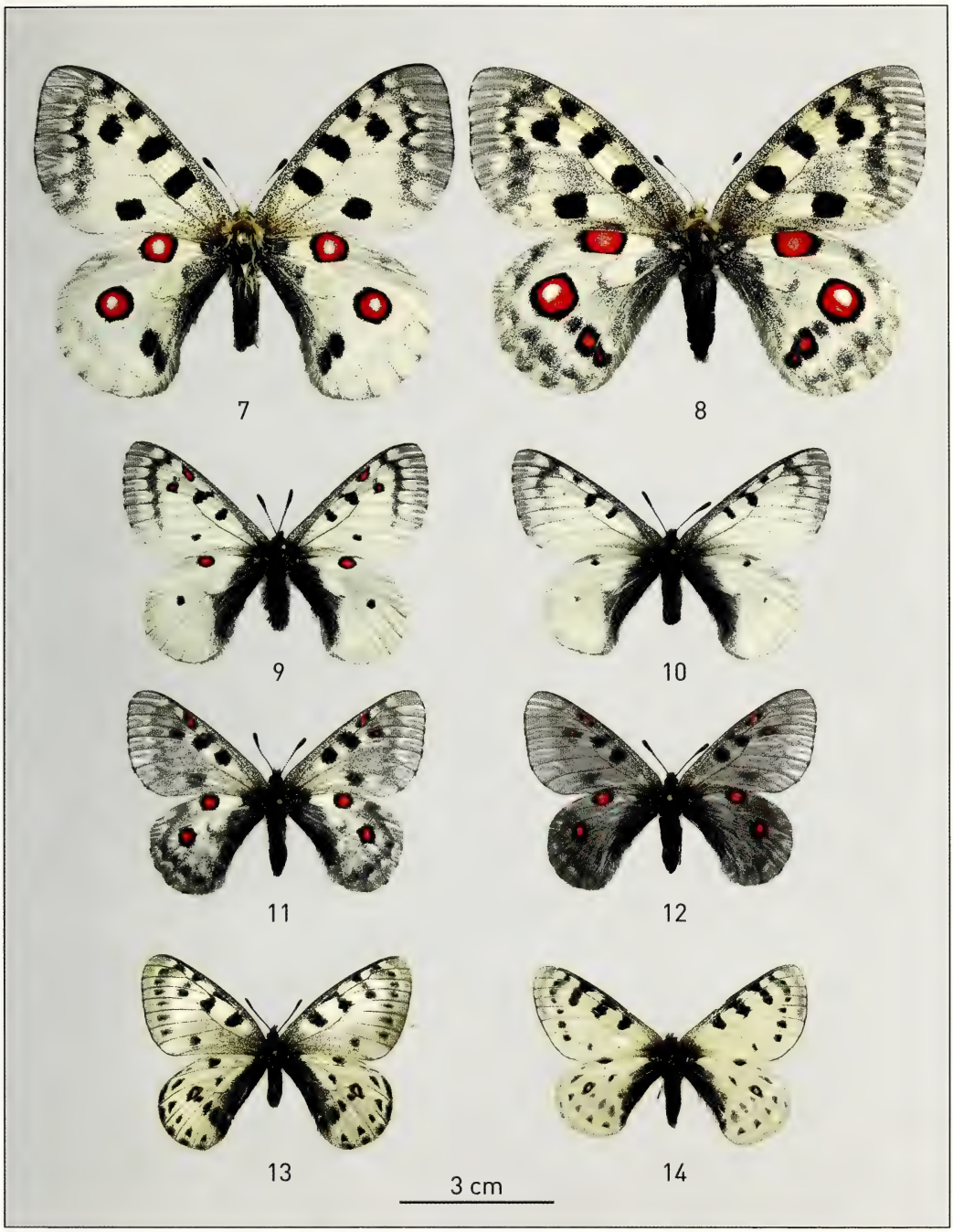
Reported for the Zhemenei valley (Lukhtanov & Lukhtanov 1994). Not found by us.

***Aricia nicias* (Meigen, 1829)** **Fig. 49**

ssp. *bittis* (Fruhstorfer, 1915)

S14. Common in forest clearings. New species to the fauna of the Saur.

Figs 2–6. 2. Saur Mt. R., Chilikty Depression, 1.vi.2006 (photo: N. Rubin); **3.** Saur Mt. R., Chagan-Obo River, 11.vi.2006 (photo: N. Rubin); **4.** Saur Mt. R., Tas Mt., 8.vi.2006 (photo: N. Rubin); **5.** Saur Mt. R., upper stream of Karagaily River, 12.vi.2006 (photo: N. Rubin); **6.** Saur Mt. R., Shakpaktas Mt. environs, alpine zone, 10.vi.2006 (photo: K. Dovgailo).



Figs 7–14. 7. *Parnassius apollo tarbagataicus*, ♂, Saur Mt. R., Terekty River valley, 1200–1300 m a.s.l., 4.vii.2003, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **8.** *Parnassius apollo tarbagataicus*, ♀, same data as 7. **9.** *Parnassius phoebus sauricus*, ♂, Saur Mt. R., Tas Mt. environs, 2500–2700 m a.s.l., 25.vi–03.vii.2003, leg. N. Rubin, K. Dovgailo & T. Dovgailo (ex coll. N. Rubin). **10.** *Parnassius phoebus sauricus*, ♂, same data as 9. **11.** *Parnassius phoebus sauricus*, ♀, same data as 9. **12.** *Parnassius phoebus sauricus*, ♀, same data as 9. **13.** *Parnassius tenedius*, ♀, Saur Mt. R., 20 km E Przhevalskoe, 24.vi.2002, leg. S. V. Ovchinnikova (ex coll. R. Yakovlev). **14.** *Parnassius tenedius*, ♂, Saur Mt. R., Temir-Su River, [191…] (ex coll. of Tomsk University).

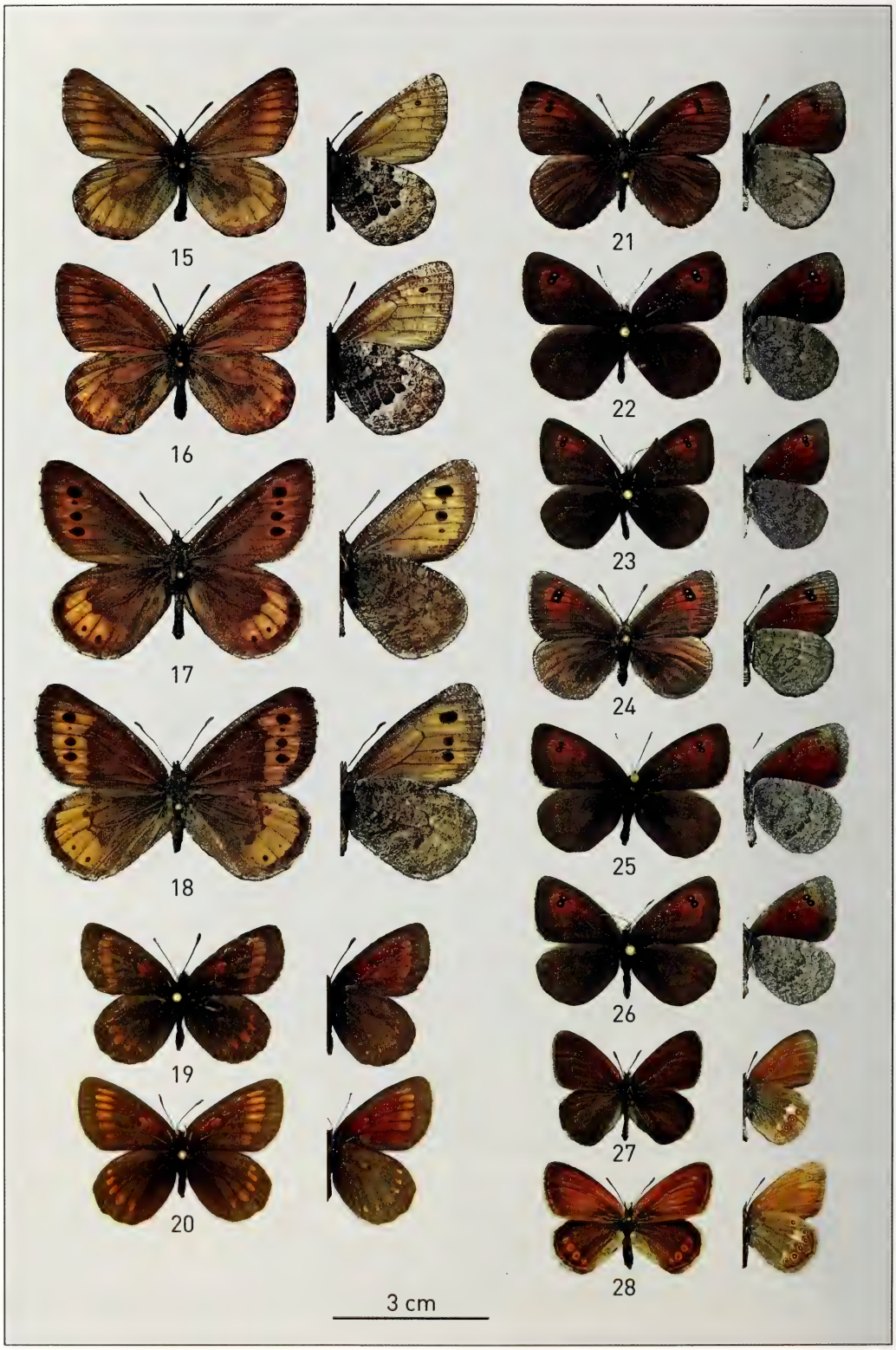

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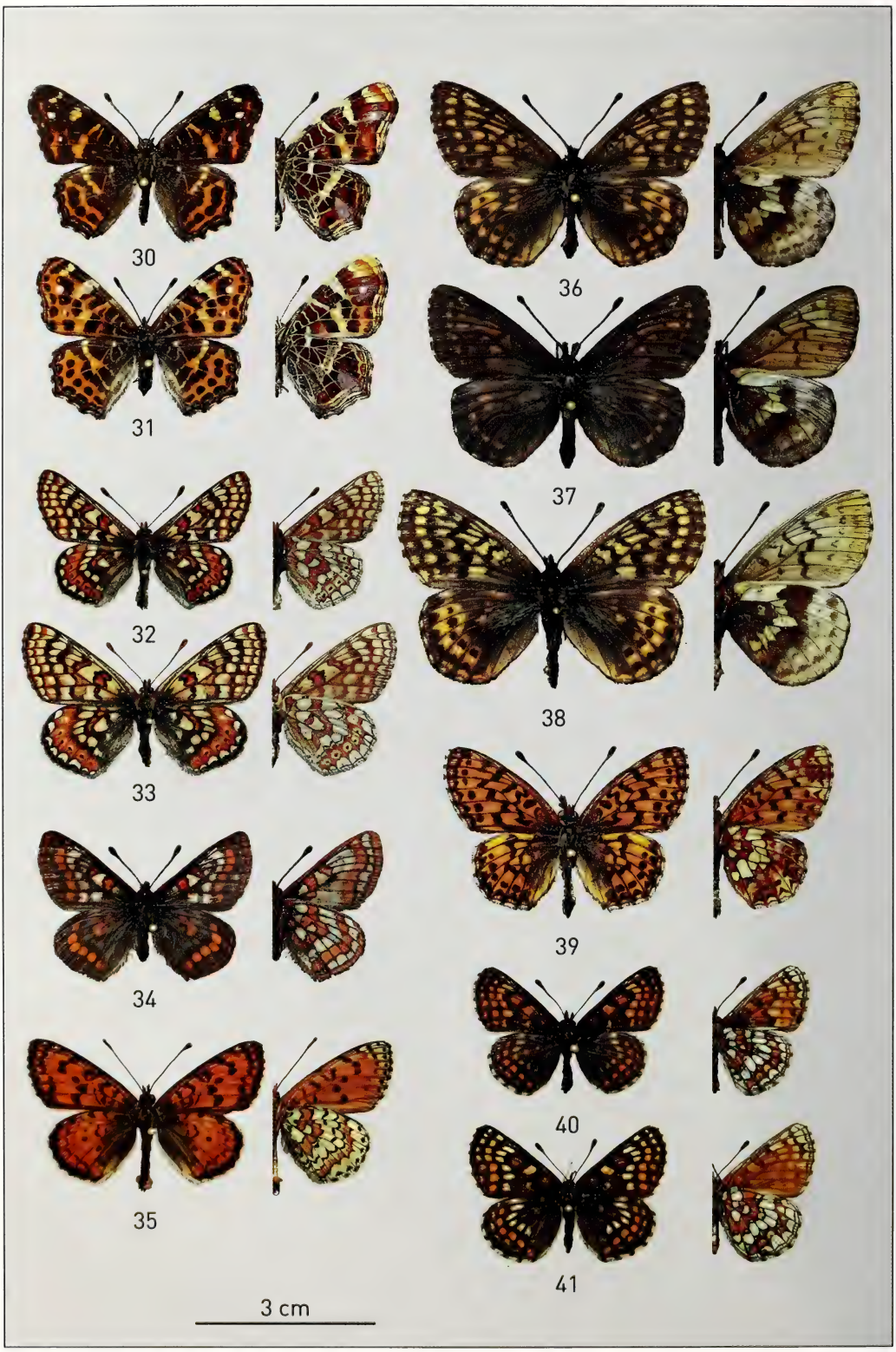
Fig. 29. Genitalia of *Erebia sibirica* Staudinger. **a–c**, ♂♂, lateral projection; **d**, ♀, frontal projection.

← **Figs 15–28. 15.** *Oeneis fulla*, ♂, Saur Mt. R., Shakpaktas Mt. environs, 2600–2700 m a.s.l., 10–14. vi.2006, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **16.** *Oeneis fulla*, ♀, Saur Mt. R., Tas Mt. environs, 2800 m a.s.l., 27.vi.2003, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **17.** *Oeneis mulla*, ♂, E Manrak Mt. R., N 47°18′40″, E 84°36′42″, 1500 m a.s.l., 1–4.vi.2006, leg. K. Dovgailo (ex coll. N. Rubin). **18.** *Oeneis mulla*, ♀, E Manrak Mt. R., N 47°18′40″, E 84°36′42″, 1400–1600 m a.s.l., 27–29.v.2011, leg. N. Rubin (ex coll. N. Rubin). **19.** *Erebia haberhaueri*, ♂, Saur Mt. R., Alatai Pass, 2010 m a.s.l., N 47°18′, E 85°08′, 23.vii.2011, leg. R. Yakovlev (ex coll. R. Yakovlev). **20.** *Erebia haberhaueri*, ♀, same data as 19. **21.** *Erebia sibirica*, ♂, Saur Mt. R., Tas Mt. environs, 2500 m a.s.l., 25.vi.2003, leg. N. Rubin (ex coll. N. Rubin). **22.** *Erebia sibirica*, ♂, Saur Mt. R., Tas Mt. environs, N 47°15′, E 85°04′, 2350–2600 m a.s.l., 20–22.vii.2011, leg. R. Yakovlev (ex coll. R. Yakovlev). **23.** *Erebia sibirica*, ♂, same data as 22. **24.** *Erebia sibirica*, ♀, Saur Mt. R., Tas Mt. environs, 2000 m a.s.l., 21.vi.2003, leg. K. Dovgailo (ex coll. N. Rubin). **25.** *Erebia sibirica*, ♀, same data as 22. **26.** *Erebia sibirica*, ♀, same data as 22. **27.** *Coenonympha glycerion iphina*, ♂, Saur Mt. R., Terekty River valley, 1300 m a.s.l., 18.vi.2003, leg. N. Rubin (ex coll. N. Rubin). **28.** *Coenonympha glycerion iphina*, ♀, Saur Mt. R., Terekty River valley, 1300 m a.s.l., 4.vii.2003, leg. N. Rubin (ex coll. N. Rubin).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Figs 30–41. 30. *Araschnia levana*, ♂, Small Zhemenei River valley, 1100 m a.s.l., 06–07.vi.2006, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **31.** *Araschnia levana*, ♀, same data as 30. **32.** *Euphydryas aurinia calima*, ♂, E Monrak Mt. R., N 47°18′40″, E 84°36′42″, 1350 m a.s.l., 27–29.v.2011, leg. N. Rubin & Yu. Sobolevskaya (ex coll. N. Rubin). **33.** *Euphydryas aurinia calima*, ♀, same data as 32. **34.** *Euphydryas iduna jakobsoni*, ♂, Saur Mt. R., upper stream of Karagaily River, 2000 m a.s.l., 10–12. vi.2006, leg. Yu. Sobolevskaya (ex coll. N. Rubin). **35.** *Melitaea ala ala*, ♂, Saur Mt. R., Terekty River valley, 1200–1300 m a.s.l., 4.vii.2003, leg. N. Rubin (ex coll. N. Rubin). **36.** *Clossiana frigga annae*, ♂, Saur Mt. R., Tas Mt. environs, 2500–2700 m a.s.l., 25.vi–03.vii.2003, leg. N. Rubin, K. Dovgailo & T. Dovgailo (ex coll. N. Rubin). **37.** *Clossiana frigga annae*, ♂, same data as 36. **38.** *Clossiana frigga annae*, ♀, same data as 36. **39.** *Clossiana selenis sibirica*, ♂, Saur Mt. R., upper stream of Karagaily River, 1900 m a.s.l., 10–12.vi.2006, leg. N. Rubin (ex coll. N. Rubin). **40.** *Mellicta menetriesi saurica*, ♂, E Manrak Mt. R., N 47°18′40″, E 84°36′42″, 1300 m a.s.l., 30.v–4.vi.2006, leg. N. Rubin, K. Dovgailo (ex coll. N. Rubin). **41.** *Mellicta menetriesi saurica*, ♀, E Manrak Mt. R., N 47°18′40″, E 84°36′42″, 1300 m a.s.l., 27–29.v.2011, leg. N. Rubin & Yu. Sobolevskaya (ex coll. N. Rubin).

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Figs 42–59. 42. *Polyommatus icadius*, ♂, Saur Mt. R., Terekty River valley, 1200–1300 m a.s.l., 4.vii.2003, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **43.** *Polyommatus icadius*, ♀, same data as 42. **44.** *Polyommatus icadius*, ♂, Saur Mt. R., 24 km S Zaisan, upper stream of Bolshoi Zhemenei River, 1650 m, N 47°14′, E 84°56′, 17–19.vii.2011, leg. R. Yakovlev (ex coll. R. Yakovlev). **45.** *Neolycaena submontana saurica*, ♂, NE Manrak Mt. R., Saryshyi environs, 700–900 m a.s.l., 04–05.vi.2006, leg. N. Rubin (ex coll. N. Rubin). **46.** *Neolycaena submontana saurica*, ♀, same data as 45. **47.** *Agriades glandon rubini*, paratypus, ♂, Saur Mt. R., Tas Mt. environs, 2300 m a.s.l., 25.vi.2003, leg. N. Rubin (ex coll. N. Rubin). **48.** *Agriades glandon rubini*, paratypus, ♀, same data as 47. **49.** *Aricia nicias bittis*, ♂, Saur Mt. R., 24 km S Zaisan, upper stream of Bolshoi Zhemenei River, 1650 m, N 47°14′, E 84°56′, 17–19.vii.2011, leg. R. Yakovlev (ex coll. R. Yakovlev). **50.** *Athamanthia dimorpha saisana*, ♂, Zaisan Lake Area, Espe River valley, 6 km NE Tolagai Mt., 600 m a.s.l., 17.vi.2006, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **51.** *Athamanthia dimorpha saisana*, ♀, same data as 50. **52.** *Phengaris alcon*, ♂, Saur Mt. R., Terekty River valley, 1200 m a.s.l., 18–19.vi.2003, leg. N. Rubin (ex coll. N. Rubin). **53.** *Phengaris alcon*, ♀, same data as 52. **54.** *Agrodiaetus damon mongolensis*, ♂, Saur Mt. R., 24 km S Zaisan, upper stream of Bolshoi Zhemenei River, 1650 m, N 47°14′, E 84°56′, 17–19.vii.2011, leg. R. Yakovlev (ex coll. R. Yakovlev). **55.** *Plebejus lepidus*, ♂, Zaisan Lake Area, Shorga River valley, 450 m a.s.l., 17.vi.2006, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **56.** *Plebejus lepidus*, ♀, same data as 55. **57.** *Plebejus idas*, ♂, Saur Mt. R., Zhemenei River valley, 5 km S Zaisan, 700 m a.s.l., 8.vi.2006, leg. N. Rubin (ex coll. N. Rubin). **58.** *Cupido tusovi*, ♂, E Manrak Mt. R., N 47°18′40″, E 84°36′42″, 1300 m a.s.l., 30.v–4.vi.2006, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **59.** *Cupido tusovi*, ♀, Saur Mt. R., Alatai Pass environs, 1500–1900 m a.s.l., 19–20.vi.2003, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin).

Figs 60–65. 60. *Parnassius ariadne clarus*, ♀, E Manrak, 31.v.2006 (photo: N. Rubin). **61.** *Euphydryas aurinia calima*, ♀, E Manrak, 29.v.2011 (photo: N. Rubin). **62.** *Athamanthia dimorpha saisana*, in copula, NW Manrak, 17.vi.2006 (photo: N. Rubin). **63.** *Cupido tusovi*, ♂, Saur, Small Zhemenei River valley, 06.vi.2006 (photo: N. Rubin). **64.** *Plebejus lepidus*, ♀, Zaisan Lake Area, Shorga River valley, 17.vi.2006 (photo: K. Dovgailo). **65.** *Neolycaena submontana saurica*, ♂, NE Manrak, 8.vi.2006 (photo: N. Rubin).

Conclusions

Altogether 159 butterfly species (Hesperiidae: 15; Papilionidae: 7; Pieridae: 17; Nymphalidae: 71; Lycaenidae: 49) have been recorded in the Saur Mountains. Four species, *Araschnia levana*, *Clossiana selenis*, *Phengaris alcon* and *Aricia nicias* are reported for the Saur for the first time. The butterfly fauna of the Saur comprises the following elements: Transpalaearctic, West Palaearctic, Dzhungarian and Siberian, as well as endemic species (5 species, or 3% of the total).

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References

Bálint, J., A. Kertézs & V. A. Lukhtanov 1993. A survey of the Subgenus *Plebejides* Sauter, 1968 (Lepidoptera, Lycaenidae). – Entomologicheskoe Obozrenie (1992) **71** (4): 863–886. [In Russian].

Bogdanov, P. V. 2003. Type material of *Clossiana frigga annae* (Suschkin, 1906) (Lepidoptera, Nymphalidae). – Trudy Gosudarstvennogo Darvinovskogo muzeya **6**: 125–126. [In Russian].

Bogdanov, P. V. 2008. Review of Satyrid Butterflies of *Erebia callias* Edwards, 1871 (Lepidoptera, Satyridae) with description of new species from the Polar Ural. – Trudy Gosudarstvennogo Darvinovskogo muzeya **12**: 161–173. [In Russian].

Bolshakov, N. M. 1987. Dendroflora of Saur-Tarbagataj Mountains area. – Novosibirsk. 174 pp. [In Russian].

Bolshakov, L. G. & S. K. Korb 2012. To the systematics and nomenclature of fritillares of the *Euphydryas aurinia* (Rottemburg, 1775) – group from Siberia and Central Asia (Lepidoptera: Nymphalidae). – Eversmannia **31–32**: 38–48. [In Russian].

Churkin, S. V. 2003. New taxa of butterflies (Lepidoptera, Rhopalocera) from Mongolia. – Helios **4**: 160–178.

Churkin, S. V. 2005a. Notes on the *Erebia maurisius* complex with the descriptions of two new subspecies (Lepidoptera, Satyridae). – Helios **6**: 146–168.

Churkin, S. V. 2005b. A review of *Agriades glandon* (de Pruner, 1798) from the Asian part of Russia and Mongolia with notes on the zoogeography of the complex (Lepidoptera, Lycaenidae). – Helios **6**: 3–38.

Churkin, S. V. 2006. A review of the *Athamanthia dimorpha* (Staudinger, 1881) species group with the description of two new subspecies (Lepidoptera, Lycaenidae). – Helios **7**: 43–76.

de Lattin, G. 1967. Grundriß der Zoogeographie. – Veb Gustav Fischer Verlag. 602 pp.

Emeljanov, A. F. 1974. Proposals of Classification and Nomenclature of Areals. – Entomologicheskoe obozrenie **53** (3): 497–522. [In Russian].

Eversmann, E. 1843. Quaedam Lepidopterorum species novae, in montibus Uralensibus et Altaicis habitantes, nunc descriptae et depictae. – Bulletin de la Société des Naturalistes de Moscou **15**: 535–555.

Eversmann, E. 1851. Description de quelques nouvelles espèces de Lepidoptères de la Russie. – Bulletin de la Societe des Naturalistes de Moscou **24** (1): 610–644.

Kamelin, R. V. 2005. New Flora of Altai (aims and conception of new floristic revision) Pp. 55–97. – *In*: R.V. Kamelin, M. G. Kuzev, D. V. Tikhonov, D. N. Shaulo, A. I. Shmakov & R. L. L. Viane, Flora Altaica **1**. – Azbuka Barnaul. [In Russian].

Kolesnichenko, K. A. 1999. A review of the East Palaearctic taxa of the *Melitaea didyma* (Esper, 1779) group. 1. The *M. ala* Staudinger, 1881-*M. chitralensis* Moore, 1901-complex. – Atalanta **30** (1/4): 87–117.

Krupitsky, A. V. & R. V. Yakovlev 2012. Description of a new subspecies of *Callophrys suaveola* (Staudinger, 1881) (Lepidoptera, Lycaenidae) from Mongolian Altai with notes on a distribution of *C. suaveola*. – Caucasian entomological bulletin **8** (2): 261–263.

Kryzhanovsky, O. L. 2002. Structure and distribution of the entomofauna of the World. – KMK-Press, Moscow. 237 pp. [In Russian].

Lukhtanov, V. A. 1984. A review of the Palaearctic satyrids of the genus *Oeneis* Hübner (Lepidoptera, Satyridae). I. *O. hora* Gr. Gr. species group. – Entomologocheskoye obozreniye **63** (4): 776–789. [In Russian].

Lukhtanov, V. A. 1990. New taxa of satyrid and blue butterflies (Lepidoptera, Satyridae, Lycaenidae) from Middle Asia and Kazakhstan. – Vestnik zoologii **1990** (6): 13–23. [In Russian].

Lukhtanov, V. A. 1999. Neue Taxa und Synonyma zentralasiatischer Tagfalter (Lepidoptera, Papilionoidea). – Atalanta **30** (1–4): 135–150.

Lukhtanov, V. A. & U. F. J. Eitschberger 2000. Illustrierter Katalog der Gattungen *Oeneis* und *Davidiana* (Nymphalidae, Satyrinae, Oenini). – Goecke & Evers, Keltern. 12 pp. + 26 cpls.

Lukhtanov, V. A. & A. G. Lukhtanov 1994. Die Tagfalter Nordwestasiens. (Lepidoptera, Diurna). – Herbipoliana, Buchreihe zur Lepidopterologie, Marktleuthen. – Vrlg. U. Eitschberger **3**. 440 pp.

Maloletko, L. M. 1999. Structure of Altai Mountains System and nomination of its parts. – Geographiya i prirodopolzovanie Sibiri. Barnaul: 23–45. [In Russian].

Speyer, A. 1879. Neue Hesperiden des paläarctischen Faunengebiets. – Stettiner Entomologische Zeitung **40**: 342–352.

Staudinger, O. 1881. Beitrag zur Lepidopteren-Fauna Central-Asiens. – Stettiner Entomologische Zeitung **42** (7/9): 253–300.

Staudinger, O. 1892. Lepidopteren des Kentei-Gebirges. – Deutsche Entomologische Zeitschrift, Iris **5**: 300–393.

Suschkin, P. 1906. Ueber eine neue *Argynnis*-Form aus Tarbagatai (Lepidoptera, Nymphalidae). – Russkoe entomologicheskoe obozrenie **6** (1–2): 5–7.

Suschkin, P. 1909. *Lycaena cyane tarbagata*, n. subsp. – Entomologische Rundschau **26**: 59.

Tuzov, V. K. (ed.) 2000. Guide to the butterflies of Russia and adjacent territories (Lepidoptera, Rhopalocera). Vol. 2. – Pensoft, Sofia-Moscow. 580 pp.

Tuzov, V. K. 2003. Nymphalidae. Part I. Tribe Argynnini: *Argynnis*, *Issoria*, *Brenthis*, *Argyreus*, [**6**]. Pp. 1–64. – *In*: G. C. Bozano (ed.), Guide to the Butterflies of the Palearctic Region. – Omnes Artes, Milano.

Verity, R. 1905–1911. Rhopalocera palaearctica. [**1**]. Papilionidae et Pieridae. – Firenze, Publ. by the author 86 + 368 pp.

Volynkin, A. V. & A. Yu. Matov 2011. A new *Syngrapha* Hubner, [1821] from the Altai Mountain Country (Lepidoptera Noctuidae). – Zootaxa **3110**: 46–52.

Warren, B. C. S. 1936. Monograph of the genus *Erebia*. – London, Tr. Brit. Mus. (Nat. Hist.). 7 + 407 pp.

Yakovlev, R. V. 2002. New data on the fauna of butterflies (Lepidoptera, Rhopalocera) in the East Palearctic Region. – Euroasian Entomological Journal **1** (2): 173–176. [In Russian].

Yakovlev, R. V. 2003. Revision of Fischer's Blue *Tongeia fischeri* (Eversmann, 1843) (Lepidoptera, Lycaenidae). – Helios **4**: 181–197.

Yakovlev, R. V. 2004. A new subspecies of *Pieris* (*napi*) *euorientis* (Verity, 1908) from the Saur Mountains (East Kazakhstan). – Helios **5**: 232–236.

Yakovlev, R. V. 2007. Two new taxa of the genus *Melitaea* Fabricius, 1807 (subgenus *Mellicta* Billberg, 1820) (Lepidoptera: Nymphalidae) are described from Western Mongolia and Eastern Kazakhstan. – Eversmannia **9**: 34–39. [In Russian].

Yakovlev, R. V. 2011. New taxa of Rhopalocera from Siberia and Kazakhstan (Lepidoptera, Satyridae and Nymphalidae) – Atalanta **42** (1–4): 225–230.

Yakovlev, R. V. 2012. Checklist of Butterflies (Papilionoidea) of the Mongolian Altai Mountains, including descriptions of new taxa – Nota lepidopterologica **35** (1): 51–96.

Yakovlev, R. V. & E. V. Guskova 2012. Saur and Tarbagataj biogeographycally: part of Altai, part of Dzhungaria or transition zone between Siberia and Middle Asia? – Materials of the conference "Animal world of Kazakhstan and adjacent territories", Almaty: 186–187. [In Russian].

Zhdanko, A. B. 1994 [1996]. New species of the Lycaenidae (Lepidoptera, Lycaenidae) from Asia. – Selevinia **1994** (1): 73–74.

Zhdanko, A. B. 2005. Butterflies (Lepidoptera, Papilionoidea, Hesperioidea) of Kazakhstan. – Tethys entomological Research **11**: 125–146. [In Russian].

New species of scythridid moths (Lepidoptera: Scythrididae) from Southern Siberia

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Abstract. Two new species of scythridid moths collected in mountain territories of Altai are described from Southern Siberia: *Scythris bidzilyai* sp. n. and *S. abruptella* sp. n. The external appearance and male genitalia of the adult are illustrated, and the species diagnosed. The relationships of the new species to similar species are discussed.

Резюме. Описываются два новых вида мрачных молей из Южной Сибири: *Scythris bidzilyai* sp. n. и *S. abruptella* sp. n., собранных в горных районах Алтая. Даются изображения имаго и генитальных структур, обсуждаются взаимоотношения с близкими видами. Типовой материал хранится в коллекции Лаборатории систематики животных и фаунистики Самарского государственного университета (Самара).

Introduction

During the last years the fauna of scythridid moths of Southern Siberia has been intensively explored. As a result annotated lists of species of this territory and descriptions of many new species have been published (Bengtsson 1997a; Bengtsson & Liška 1996; Nupponen 2003, 2005, 2007; Sachkov & Sinev 2001; Sinev 1993, 2001). It has become obvious that the knowledge of Lepidoptera (including scythridid moths) occurring in this territory is far from complete. It can be expected that more new species, as well as new distribution records of already described species will be found from adjacent territories.

Some small but interesting material, mainly collected by Russian entomologist P. Ya. Ustyuzhanin and also by Ukrainian entomologist O. Bidzilya from Altai, has been received and included into the collection of the Laboratory of Animals Systematics and Faunistics of the Samara State University. Examination of this material included two new species that are described here.

Abbreviation

LSSU Laboratory of Animals Systematics and Faunistics of Samara State University, Samara

Scythris bidzilyai sp. n. Figs 1, 3

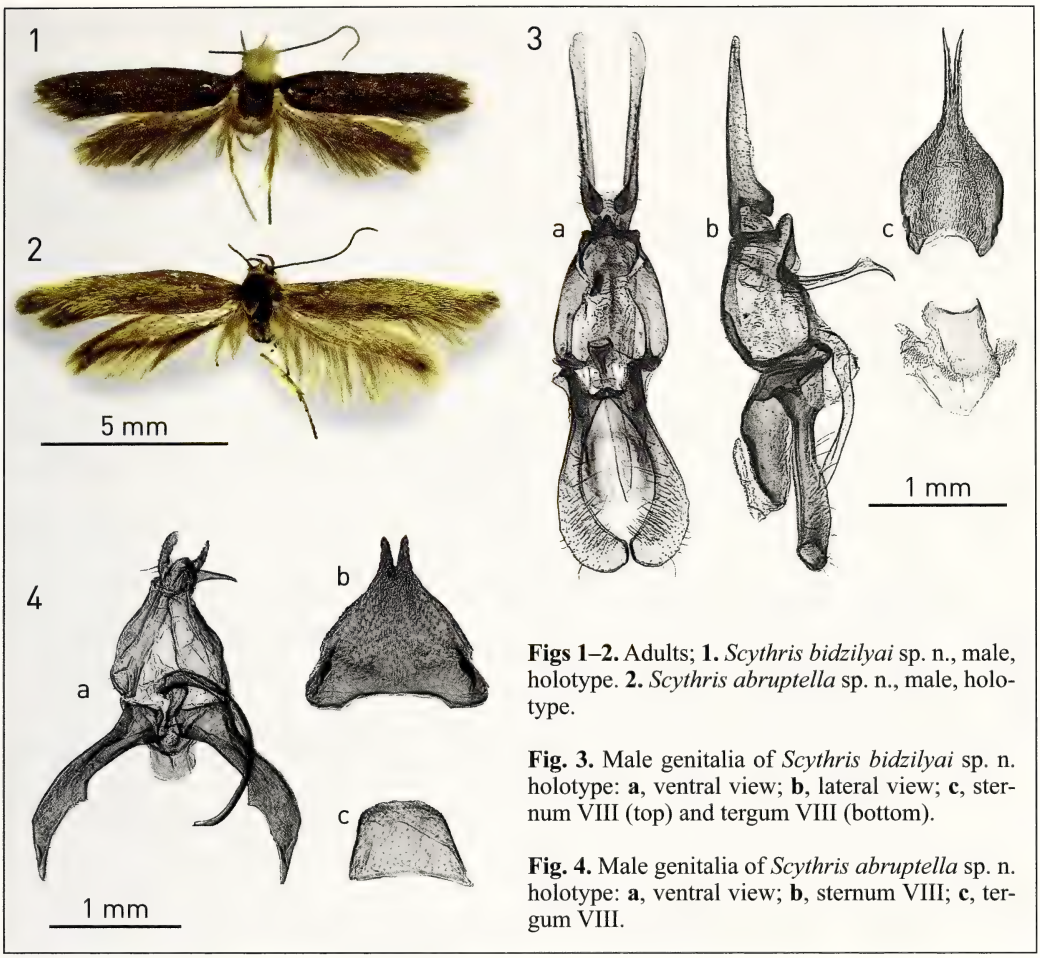
Material. Holotype ♂, 'Россия, Алтай | Онгудайский р-н | 15 км ниже с. Иодро | по р. Чуя, 6.08.2000 | А. Бидзиля [Russia, Altai, Onghudai Distr., 15 km downstream of Chuya from Iodro vil., 6.08.2000, A.Bidzilya leg.]' <white rectangle, printed in black ink>, 'HOLOTYPUS | *Scythris bidzilyai* Satshkov sp. n. ♂ | Алтай' <red rectangle, printed in black ink> (LSSU).

Description. Adult (Fig. 1). Wingspan 13 mm. Head, antenna, haustellum, collar, tegula, thorax and forewing dark brown with slight bronze tinge, without pattern. Hindwing fuscous. Basal segment of labial palpus with erect pale-coloured scales, second and third segments greyish-brown, basal half of second segment with sparse scattered light-coloured scales. Legs greyish-brown, hindtibia covered by whitish scales and paler than femur, but spurs dark, contrasting with the pale tibia, brush of tibial bristles fuscous.
Male genitalia (Fig. 3). Uncus with two slender long, parallel lobes slightly widening towards tip in ventral projection and pointed in lateral aspect; ventral edge basally with two strongly sclerotized oblique processes. Uncus almost 1.5 × length of tegumen. Tegumen large. Basal plate of gnathos straight with triangular medial process; medial process of gnathos long, straight with pointed tip bent downwards, in distal part with large semicircular process on dorsal edge. Phallus long, slightly sigmoid in basal part. Valva curved, distally broadened and rounded. Vinculum large, X-shaped, caudal lobes larger than proximal lobes, widely rounded; depression between them deep U-shaped, medially with narrow chink-form cut. Tergum VIII subquadrangular, membranous. Sternum VIII elongate, distally bifurcate, deeply (up to 1/3) split.
Female genitalia. Unknown.
Diagnosis. *S. bidzilyai* sp. n. belongs to the *pascuella*-group (sensu Bengtsson 1997b) and to the *bifissella*-complex embracing *S. bifissella* (Hofmann, 1889), *S. minorella* Sinev, 2001, *S. sibirella* Sinev, 2001, and *S. hemicycliella* Nupponen, 2005. It is separated from all those species by its long lobes of uncus, the shape of basal processes on the lobes and also details of gnathos, the shape of valva and the sternum VIII. By the length of uncus lobes it resembles *S. tabescentella* (Staudinger, 1880) but *S. bidzilayi* sp. n. differs from it by the shape of the gnathos, valva and possibly the smaller size of the imago.
Biology. Unknown. Flight period probably in the first half of August. The holotype was collected in a river valley.
Distribution. Only known from the type locality.
Etymology. The species is named after O. Bidzilya, a Ukrainian lepidopterist who collected the holotype.

Scythris abruptella sp. n. Figs 2, 4

Material. Holotype ♂, 'Респ[ублика] Алтай, | Кош-Агачский р-н, | 5 км СВ п. Чаган- | Узун | 9.VII.2007 | leg. Устюжанин П.Я.' <white rectangular in black frame, printed in black ink>, 'HOLOTYPUS | *Scythris abruptella* Satshkov sp. n. ♂ | Алтай' <red rectangular, printed in black ink> (LSSU).

Description. Adult (Fig. 2). Wingspan 14 mm. Head, haustellum, collar, tegula, thorax and forewing yellowish-brown; antenna darker. Hindwing pale fuscous, slightly lighter than forewing. Fringe basally darker than in distal part. Basal segment of labial palpus with erect light-coloured scales, other segments pale on upper side and slightly darker on underside. Legs and underside of thorax covered by pale scales.
Male genitalia (Fig. 4). Uncus short, bilobed, almost twice shorter than tegumen. Basal plate of gnathos rounded triangle; medial process of gnathos straight, smoothly



Figs 1–2. Adults; **1.** *Scythris bidzilyai* sp. n., male, holotype. **2.** *Scythris abruptella* sp. n., male, holotype.

Fig. 3. Male genitalia of *Scythris bidzilyai* sp. n. holotype: **a**, ventral view; **b**, lateral view; **c**, sternum VIII (top) and tergum VIII (bottom).

Fig. 4. Male genitalia of *Scythris abruptella* sp. n. holotype: **a**, ventral view; **b**, sternum VIII; **c**, tergum VIII.

tapering to tip, apically slightly down-curved. Phallus arched, smoothly tapering to tip. Valva rather curved, medially broadened, distally elongate, near tip with small sharp process, not reaching top of valva. Inner margin of valva medially with triangular tooth. Vinculum chute-shaped. Tergum VIII trapezoid; sternum VIII triangular posteriorly bifurcate, depth of apical incision 3.8 times shorter than another part of sternum.

Female genitalia. Unknown.

Diagnosis. *S. abruptella* sp. n. belongs to the *obscurella*-group (Bengtsson 1997b). From similar species, e.g., *S. hornigii* (Zeller, 1855) and *S. speyeri* (Heinemann, [1876]), the new species differs in male genitalia by the shape of the valva with strongly elongate sharp tip, large medial tooth on the inner margin of the valva, and by the absence of a whitish long streak in the forewing. *S. bengtssoni* Patočka & Liška, 1989 has a small subapical process on the valva near its apex but it lacks a tooth on the inner margin of the valva. The shape of the phallus and sternum VIII also separates *abruptella* and *bengtssoni*, as do the external features.

Biology. Flight period of the imago is in the first third of July.

Distribution. Altai.

Etymology. Abruptus (*Lat.*) – unexpected. The species name is based on the unexpected status as a new species after the dissection of genitalia.

Acknowledgements

I am very grateful to Dr Sergey Yu. Sinev (St. Petersburg, Zoological Institute of RAS) for providing access to the collection of ZISP, and for confirming the status of the above described species as new. I am very thankful to Dr Oleksy Bidzilya and Dr Peter Ya. Ustyuzhanin for letting me examine their material of Scythrididae. I also wish to express my sincere thanks to Mr Dmitry F. Shovkoon for the photographs of moths and their genitalia.

References

Bengtsson, B. Å. 1997a. Notes on interesting scythridids in the Zoological Museum, Helsinki, Finland (Lepidoptera, Scythrididae). – Entomologica Fennica **8** (2): 89–102.

Bengtsson, B. Å. 1997b. Scythrididae. Pp. 1–301. – *In*: P. Huemer, O. Karsholt & L. Lyneborg (eds), Microlepidoptera of Europe, Vol. **2**. – Apollo Books, Stenstrup.

Bengtsson, B. Å. & J. Liška 1996. Notes on Asian scythridids with description of four new species (Lepidoptera: Scythrididae). – Phegea **24**: 33–39.

Nupponen, K. 2003. Contribution to the scythridid fauna of southern Buryatia, with description of seven new species (Lepidoptera: Scythrididae). – Entomologica Fennica **14**: 25–45.

Nupponen, K. 2005. Notes on Palaearctic Scythrididae, with description of two new species (Lepidoptera: Scythrididae). – Entomologica Fennica **16**: 165–174.

Nupponen, K. 2007. Notes on the Scythrididae fauna of the Volgo-Ural region and southern Buryatia, with one new synonym and descriptions of six new species (Lepidoptera: Scythrididae). – SHILAP Revista de Lepidopterologia **35** (138): 231–249.

Sachkov, S. A. & S. Yu. Sinev 2001. A new species of the genus Scythris Hbn. (Lepidoptera, Scythrididae) from Transbaikalia. – Proceedings of the Zoological Institute, St. Petersburg **291**: 27–30. [In Russian].

Sinev, S. Yu. 1993. New and little-known species of the genus *Scythris* (Lepidoptera, Scythrididae) from Altai. – Vestnik Zoologii **2**: 53–57. [in Russian].

Sinev, S. Yu. 2001. New and little-known species of the genus *Scythris* Hbn (Lepidoptera, Scythrididae) from the Asiatic part of Russia. – Proceedings of the Zoological Institute, St. Petersburg **291**: 3–26. [In Russian].

The first record of *Holoterpna pruinosata* (Staudinger, 1897) (Geometridae) from Ukraine

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Abstract. The first record of the rare European geometrid moth *Holoterpna pruinosata* (Staudinger, 1897) for the fauna of the Ukraine is presented. Immature stages and adults are figured.

Introduction

Holoterpna pruinosata (Staudinger, 1897) was recorded from northeasternmost Italy, Slovenia, Turkey, Lebanon, and Israel (Hausmann 2001). The species was found by the authors in two localities in eastern Crimea (Fig. 1). Since it is absent from the recent list of Ukrainian Geometridae (Kostjuk 2004) and neither listed for that country in the database of European Lepidoptera (Karsholt & Nieukerken [eds] 2012), we report it as new for the fauna of the Ukraine.

Material and Methods

Ukraine, Crimea, 2 km NW of Staryy Krym, Agarmysh Mt., 600 m, steppefied rocky south-facing slope, 31.vii.2009, Savchuk & Kajgorodova leg., 12 final instar larvae; 2 viii.2010, Savchuk leg., several dozens of final instar larvae; 31.vii.2011, Savchuk leg., more than a hundred larvae of different, mainly early instars. Ukraine, Crimea, 5 km N of Krasnokamenka, Frenk-Mezer Mt., 660 m, 3.viii.2009, Kajgorodova leg., steppefied rocky hilltop, 3 final instar larvae.

Collected larvae were reared on the natural host plant, but under artificial conditions. Ova were obtained from reared adults, which produced additional larvae. Identification was carried out using external features of adults.

Results and discussion

During faunistic surveys in 2009, we discovered two populations of the rare geometrid moth *Holoterpna pruinosata* (Staudinger, 1897) on an extensive xerophytic south-eastern hillside of Agarmysh Mt. and on a moderately-sized bare hilltop of Frenk-Mezer Mt. Both localities are situated in south-eastern Crimea, the distance between them is approximately 10 km.

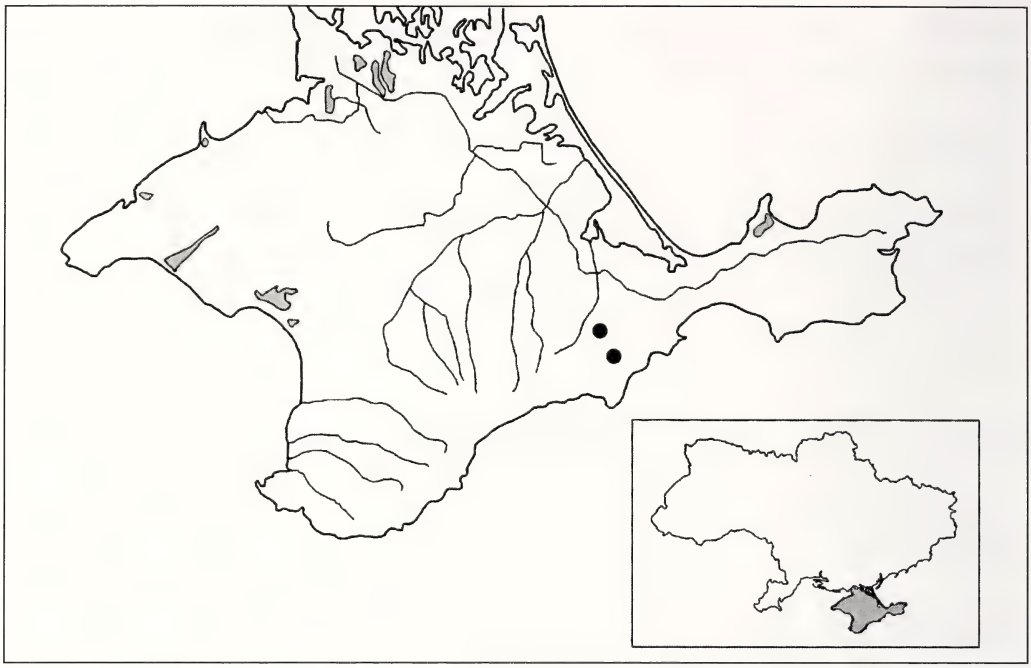

Fig. 1. Distribution of *Holoterpna pruinosata* (Staudinger, 1897) in the Crimea.

From 2010 to 2012 we conducted further research on the phenology and life history of this species. For that purpose the Agarmysh population was studied because it is more easily accessible.

The Agarmysh Mountain represents an approximately 6 km long ridge, stretching from northeast towards southwest, with a maximum elevation of 722 m. The northern slope is covered by deciduous woodland, the southern slope includes extensive patches of xerophytic, open habitats. The vegetation of the latter is dominated by *Poa sterilis* Bieb., *Bromopsis cappadocica* (Boiss. et Bal.) Holub, *Cleistogenes serotina* (L.) Keng, *Asphodeline taurica* (Pall. ex Bieb.) Kunth, *Anthyllis biebersteiniana* Popl., *Sideritis catillaris* Juz., *Salvia scabiosifolia* Lam. s.l., *Ferulago galbanifera* (Mill.) Koch, *Artemisia caucasica* Willd., *Cerastium tauricum* Spreng., *Cerastium glutinosum* Fries, *Holosteum umbellatum* L., *Coronilla scorpioides* (L.) Koch, *Muscari neglectum* Guss., *Gagea* spp. and *Ornithogalum* spp. (Kamenskikh 2011).

Under natural conditions all larvae were found among the fruits of *Ferulago galbanifera* (Mill.) W.D.J. Koch (Apiaceae) (Fig. 2). The adult larva is short and plump, greenish-yellow, with a reddish head. Ventral side without pattern, dorsally with 10 brown transverse fasciae, the four outer ones significantly less pronounced than the rest. In captivity the larvae were reared on the natural host plant; apart from that, they successfully accepted generative parts of *Foeniculum vulgare* Mill. (Apiaceae). The larva attaches itself to the host plant's peduncles with its prolegs and feeds on nearby flower buds, flowers and developing fruits. At rest it takes up a characteristic curved position (Fig. 3). In captivity the larval development from hatching from egg to completion of feeding took 20 days. For pupation the larva builds, among leaf litter or in

Fig. 2. *Ferulago galbanifera* (Mill.) W.D.J. Koch (Apiaceae), larval host plant.

the soil, a yellow, loose, reticulate cocoon. Pupation takes place two days after the completion of the cocoon; no larval aestivation was observed.

Male pupae are 11–13 mm long, those of females 14–16 mm, ochreous with dark speckling, most conspicuous on the wing shafts (Fig. 4). The cremaster bears a row of eight hooked setae (Fig. 5). Pupae overwinter, many do so twice. In captivity we observed one case of development without a diapause with the adult emerging shortly after pupation. In that case the pupal stage lasted for 14 days.

Emergence of moths from pupae that overwintered in captivity took place between May 18 and July 2. However, judging from the larval records in nature, we assume that the natural flight period takes place during the second half of July.

Fig. 3–5. *Holoterpna pruinosata* (Staudinger, 1897), Crimea, 2 km NW of Staryy Krym, Agarmysh Mt., 600 m, 31.vii.2009. **3.** Final-instar larva; **4.** Pupa; **5.** Cremaster of pupa.

Moths emerge during the afternoon with males starting to actively fly in the evening of the same day, looking for females and mating with them. Oviposition starts two days after mating. Ova are glabrate, oval, yellow, and deposited either singly or in groups on the shoots and flower buds of the host plant. Egg development takes five days.

Figs 6, 7. *Holoterpna pruinosata* (Staudinger, 1897), Crimea, 2 km NW of Staryy Krym, Agarmysh Mt., 600 m. **6.** Ex larva, ♂, 24.vi.2012. **7.** Ex larva, ♀, 20.vi.2012.

Adults are aphagous, in captivity their lifespan is between two and seven days. Forewing length is 10–14 mm in males, 14–18 mm in females. Ground colour of head, pronotum, legs, abdomen and wing upper side is plain bluish-green (Figs 6, 7); in some individuals the hindwings are paler coloured than the forewings. Forewing costal margin and antennal shaft are white. Underside of both fore- and hindwings is bluish-green, gradually becoming paler towards the anal margin, which is almost white. Proboscis is reduced.

Our records significantly expand the known distribution of *H. pruinosata* both in Europe and globally. Since the species was reported for Europe as 'highly endangered, perhaps near extinction' (Hausmann 2001) our records may also be of interest to those working on nature conservation.

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References

Hausmann, A. 2001. Introduction. Archiearinae, Orthostixinae, Desmobathrinae, Alsophilinae, Geometrinae. Pp. 1–282. – *In*: A. Hausmann (ed.), The Geometrid Moths of Europe **1**. – Apollo Books, Stenstrup.

Kamenskikh, L. N. 2011. Flora and vegetation of the Agarmysh ridge. – Bulleten' Glavnogo Botanicheskogo Sada **195**: 91–129. [In Russian.]

Karsholt O. & E. J. van Nieukerken (eds) 2012. Fauna Europaea: Lepidoptera. – Fauna Europaea, version 2.5, http://www.faunaeur.org. Accessed 15 June 2013.

Kostjuk, I. Yu. 2004. Modern state of study of Geometridae (Lepidoptera) in Ukraine: preliminary list and new records. – Proceedings of the Zoological Museum of Kiev Taras Shevchenko National University, Vol. **2**: 93–109. [In Ukrainian].

Dorsispina furcicornaria, a new geometrid species and new genus from Kazakhstan (Lepidoptera: Geometridae: Ennominae)

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Abstract. A new geometrid genus, *Dorsispina*, with the type species *Dorsispina furcicornaria* **sp. n.** (Lepidoptera: Geometridae: Ennominae), is described and illustrated from the River Emba, western Kazakhstan. A single adult male was found in late September, flying rapidly in sunshine about two hours before sunset in a sandy riverside dune surrounded by chalk steppes. The species has several unique, diagnostic features not seen in other Palaearctic Geometridae, for instance a thorax with a Y-shaped sclerotised extension and abdominal tergites 3–8 that are densely covered with sclerotised spines. Systematic position of *Dorsispina* within the Ennominae is uncertain; it is tentatively classified in the Ennominae tribe Boarmiini. Various abdominal sclerotisations across Ennominae taxa from the tribes Boarmiini (*Biston* Leach, [1815] 1830 and related genera), Wilemanini and Desertobini, are illustrated and their potential relationships are discussed.

Introduction

The first author has collected Lepidoptera very extensively in Russia, particularly in the Ural area, western Kazakhstan and southern Siberia. Since 1996, altogether about 45 field trips have been carried out, comprising 22 months in the field. During a field trip in Kazakhstan in September 2012, an unknown, diurnal Geometridae species was discovered (Fig. 1). The encounter was unusual: while taking a bath in the middle of a shallow river, the moth flew rapidly like a bullet towards the senior author and landed in the water. The long-haired moth became wet immediately and sunk into the water within a few seconds. The specimen was captured by hands and put in a soap box for carrying to the base camp, where it was dried and set.

Examination of its morphology revealed it to have unique structures, for instance a Y-shaped sclerotised extension on its thorax, which has not been described for any Geometridae taxa in the Palaearctic region. The purpose of this paper is to describe the above mentioned taxon as a new species, to classify it into a new genus, and to assess its systematic position within the Ennominae.

Methods

To minimize the risk of creating a new synonym, we examined all pertinent literature (e.g., Mironov et al. 2008; Prout 1912–16; Viidalepp 1996; Wehrli 1939–1954; Zoological Record Plus 2013), studied all the relevant taxa listed in *The Geometrid Moths of the World* (Parsons et al. 1999), and examined specimens at major entomological collections. The latter include for instance The Natural History Museum, London,

United Kingdom (BMNH), the Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia (ZRAS) and Zoological Museum of the Finnish Museum of Natural History, Helsinki, Finland (ZMH). We also consulted numerous lepidopterists, particularly in Russia, who are experts in the local fauna and who have access to local museum collections and who know the holdings extensively.

Genitalia were prepared following methods described by Hardwick (1950). Terminology for the male genitalia follows Klots (1970) and Kristensen (2003) and for the wing venation McGuffin (1977). Nomenclature follows Parsons et al. (1999).

A comparative morphological method was used, i.e. the morphology of the new taxon was compared against other potentially related taxa, to infer the systematic position of the taxon in question. The approach relies on similarities only, homologies of the structures were not tested in a phylogenetic context.

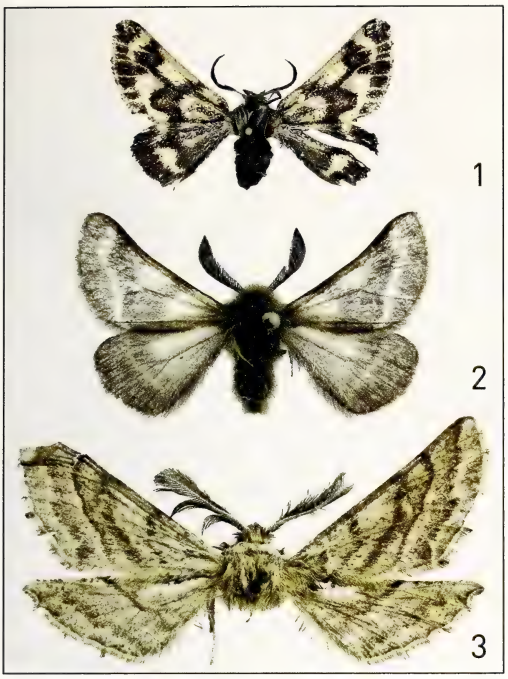
Dorsispina gen. n.

Type species: *Dorsispina furcicornaria* **sp. n.**
Diagnosis. Brown and beige wings, combined with brown line in the middle of forewing, which is parallel with costa (Fig. 1). Thorax with a Y-shaped sclerotised extension (Fig. 7). Abdominal tergites 3–8 densely covered with sclerotised spines (Fig. 14). The male genitalia with asymmetric uncus and no gnathos. Phallus is narrow, curved, and vesica is without sclerotisations.
Description. See below the description of *Dorsispina furcicornaria* **sp. n.**
Systematic position. The position within Ennominae is supported by the wing venation, particularly by the hindwing vein M_2, which is vestigial, yet weakly tubular. The genus is tentatively classified in the tribe Boarmiini (*sensu* Holloway 1994), due to similarities with a few Palaearctic taxa in habitus, male genitalia and abdominal sclerites. See Figs 1–6 and Discussion.
Etymology. The genus name *Dorsispina* refers to the abdominal tergites 3–8, which are densely covered with stout sclerotised spines. The name is derived from Latin: *dorsi* = genitive form of dorsal, *spina* = thorn.

Dorsispina furcicornaria sp. n. — Figs 1, 4, 7, 14

Material. Holotype ♂, labeled: 'HOLOTYPE | *Dorsispina* | *furcicornaria* | Nupponen & Sihvonen [red rectangle label]', 'KAZAKHSTAN | 47°12′25″ N 55°28′49″ E | Emba river, 47 m [a.s.l.], | Besbai village 2 km E | 25.9.2012, K. Nupponen leg.', 'Prep. number 1877 | Pasi Sihvonen', 'DNA sample | No. 175 | Pasi Sihvonen' (coll. Kari & Timo Nupponen, Espoo, Finland)'. Holotype can be borrowed via Zoological Museum of the Finnish Museum of Natural History, Helsinki, Finland.

Diagnosis. *Dorsispina furcicornaria* does not externally resemble any other Geometridae species in the Palaearctic region. The colour and pattern of wing markings, brown and beige, remotely resemble *Chondrosoma fiduciaria* Anker, 1854 (Fig. 2) and *Narraga* Walker, 1861 species (Macariini) but the patterns are different. The stout abdomen and short, triangular forewings are found in numerous Boarmiini taxa (e.g., *C. fiduciaria*



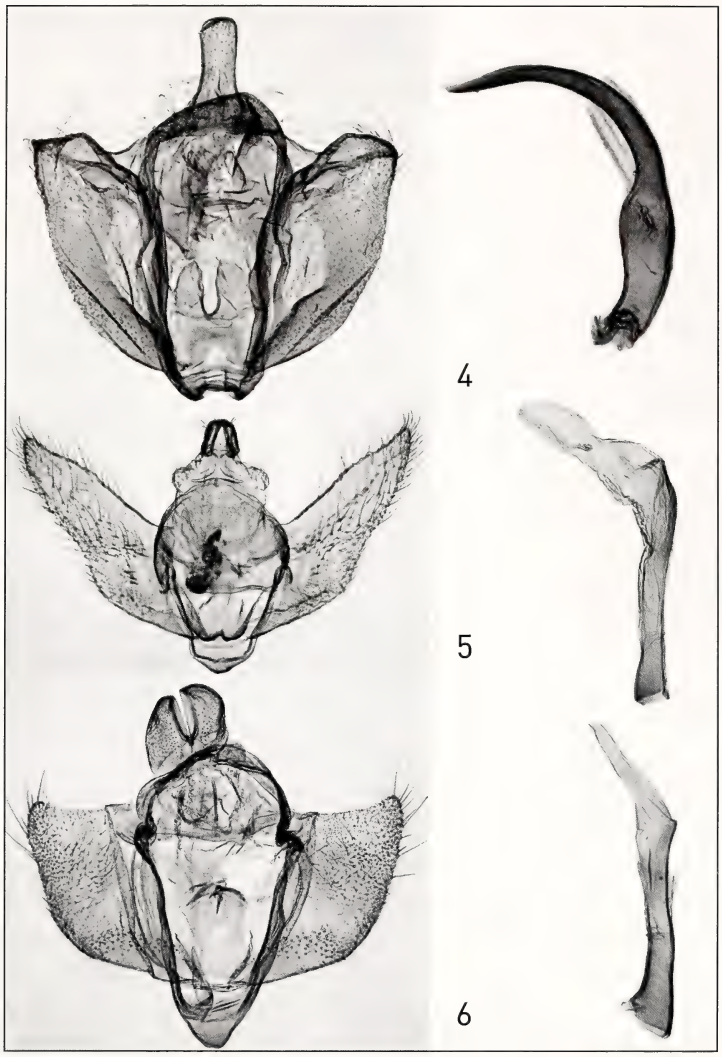
Figs 1–3. Adult males of *Dorsispina furcicornaria* and morphologically similar species. **1.** *D. furcicornaria,* holotype. **2.** *Chondrosoma fiduciaria*, Austria: Münchendorf, 23.x.1910 (wingspan 25 mm, coll. ZMH). **3.** *Apochima flabellaria*, Italy: Sardinia, 22.i.1987 (wingspan 37 mm, coll. ZMH).

Anker, 1854, *Apocheima hispidaria* [Denis & Schiffermüller], 1775, and *Lycia zonaria* [Denis & Schiffermüller], 1775), but the external appearance of those are different. The thorax with a Y-shaped sclerotised extension (Fig. 7) and abdominal tergites 3–8, which are densely covered with sclerotised spines (Fig. 14), are unique. The male genitalia of *Apochima flabellaria* (Heeger, 1838) (Fig. 6) are somewhat similar but the costa of the valva is not sclerotised (it is sclerotised in *D. furcicornaria*), the uncus is bilobed (single in *D. furcicornaria*) and the phallus is straight (curved in *D. furcicornaria*).

External characters and pregenital abdomen. Male. Wingspan 20 mm (n = 1). Wings brown and beige, weakly suffused with brown, particularly near base (Fig. 1). Medial line (homology tentative) brown, narrow and curved inwards near costa. Postmedial line (homology tentative) wide on costa, narrow in the middle and parallel with costa, partly fused with medial line near inner margin. Terminal area brown, interrupted by beige veins. Forewing apex with beige wedge. Terminal line beige, concolorous with wings. Fringes brown. Lines continued on hindwings. Discal spots indistinct, brown, elongated. Wings below as above, slightly paler. Forewing with 5 radial veins, veins R_{3-5} arising from common stalk. Accessory cells absent. Hindwing veins $Sc+R_1$ and Rs parallel, not fused. Hindwing vein M_2 vestigial, weakly tubular. Eyes small. Frons, collar and thorax mixed brown and beige. Thorax with prominent, Y-shaped sclerotised extension, with smaller lateral lobes at base (Fig. 7). Antennae bipectinate, pectinations long. Foreleg tibia with flat epiphysis, about same length as tibia. Hindleg tibia not swollen, with two minute apical spurs. Abdomen blackish. Tympanal organs large, sclerotised, almost meeting medially. Ansa bottle-shaped, very wide at base. Sternite 2 sclerotised, other sternites undifferentiated. Tergite 2 with narrow, long setae. Tergites 3–8 densely covered with sclerotised spines, base beige, apex dark (Fig. 14). Head, thorax and abdomen covered with long hair, majority of these were detached during immersion in water and the consequent drying process.

Variation. Unknown, only one male is known. See Remarks.

Genitalia. Male genitalia (Fig. 4). Uncus wide, spatulate, weakly setose. Socii small, membranous, covered with setae. Gnathos absent. Tegumen narrow, sclerotised. Juxta large, U-shaped, posterior margin deeply invaginated. Valva wide, short, mem-



Figs 4–6. Male genitalia and phallus of *Dorsispina furcicornaria* and morphologically similar species (figures not to scale). **4.** *D. furcicornaria*, holotype (coll. Nupponen, slide 1877/Pasi Sihvonen). **5.** *Chondrosoma fiduciaria*, Hungary: Budapest, 28.x. 1945 (coll. ZMH, slide 1390/Pasi Sihvonen). **6.** *Apochima flabellaria*, Italy: Sardinia, 22.i.1987 (coll. ZMH, slide 1405/Pasi Sihvonen).

branous. Ventral margin slightly concave below apex. Dorsal margin (costa) sclerotised, weakly triangular. Apex weakly setose, with minute hook. Saccus concave. Phallus curved, widest in the middle, tapering towards acute apex. Caecum absent. Vesica not everted, presumably narrow tube, without sclerotisations. Female genitalia. Female is unknown.

Distribution. Only the holotype male is known from western Kazakhstan.

Biology. The flight period of the *D. furcicornaria* is presumably restricted to late autumn. The moth was observed in late September, and during the same period the flight of some other late autumn species started in the region, such as *Dasypolia timoi* Fibiger & Nupponen, 2006, *Ulochlaena hirta* (Hübner, [1813]) and *Deuterotinea casanella* Eversmann, 1844. *D. furcicornaria* seems to be diurnal: the specimen was in active flight about two hours before sunset (i.e. at 6 p.m.) in sunshine. The temperature was > 25°C, there was a clear sky and no wind. The collecting site is a riverside sand dune,

Fig. 7. Dorsal Y-shaped sclerotisation on the thorax of *Dorsispina furcicornaria*, holotype; **a**: ventral view; b: lateral view.

surrounded by a large chalk steppe (Fig. 8). The potential habitats of *D. furcicornaria* are riverside sand dunes and chalk steppes (Fig. 9). The immature stages remain unknown.

Etymology. The species name *furcicornaria* refers to the fork-shaped, horn-like dorsal sclerotisation on the thorax. The name is derived from Latin: *furca* = fork, *cornu* = horn and the ending *-aria* refers to the pectinate antennae.

Remarks. Only a single male of this new taxon is known. Potentially one additional specimen exists in the Falcovitsch collection in the Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia (Jaan Viidalepp, pers. comm.). Despite efforts, the specimen has not been located (Vladimir Mironov, pers. comm.). A foreleg of the holotype has been submitted to the DNA analysis (barcode region of the mitochondrial cytochrome oxidase I (COI) gene, 658 base pairs) to be carried out in the Canadian Centre for DNA Barcoding, Ontario, Canada. The holotype has been under water, thus potentially diminishing the probability of recovering the DNA. At the time of manuscript preparation, the BOLD database (www.boldsystems.org) did not contain DNA barcodes of the taxa that are morphologically similar to *D. furcicornaria*.

Discussion

The systematic position of *Dorsispina furcicornaria* within the Ennominae is uncertain. We place it tentatively in the tribe Boarmiini *sensu* Holloway (1994; see also Sihvonen et al. 2011, who provided molecular support for Holloway's broad concept of Boarmiini), in the group of taxa that were classified earlier in Bistonini. Lack of phylo-

Figs 8, 9. Collecting site of *Dorsispina furcicornaria*. **8.** Kazakhstan: Aktyubinskaya Oblast, Emba river, 2 km East of Besbai village, 25.ix.2012. Photo: Kari Nupponen. **9.** The edge of riverside sand dunes and chalk steppe, habitat of *Dorsispina furcicornaria*. Photo: Pavel Gorbunov.

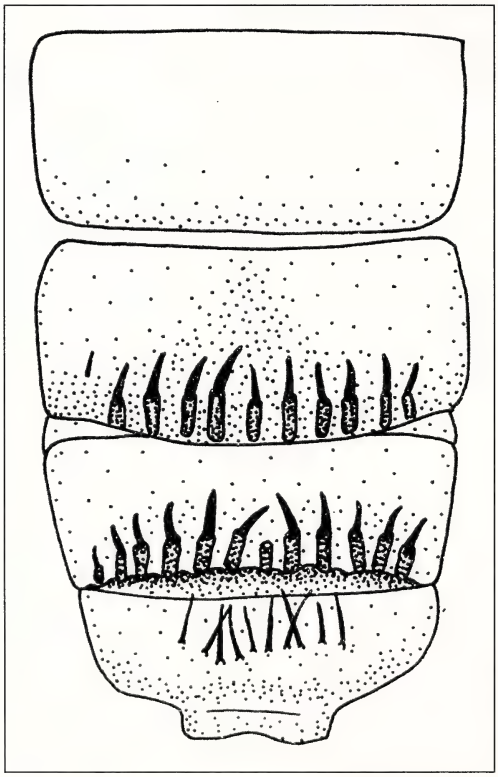
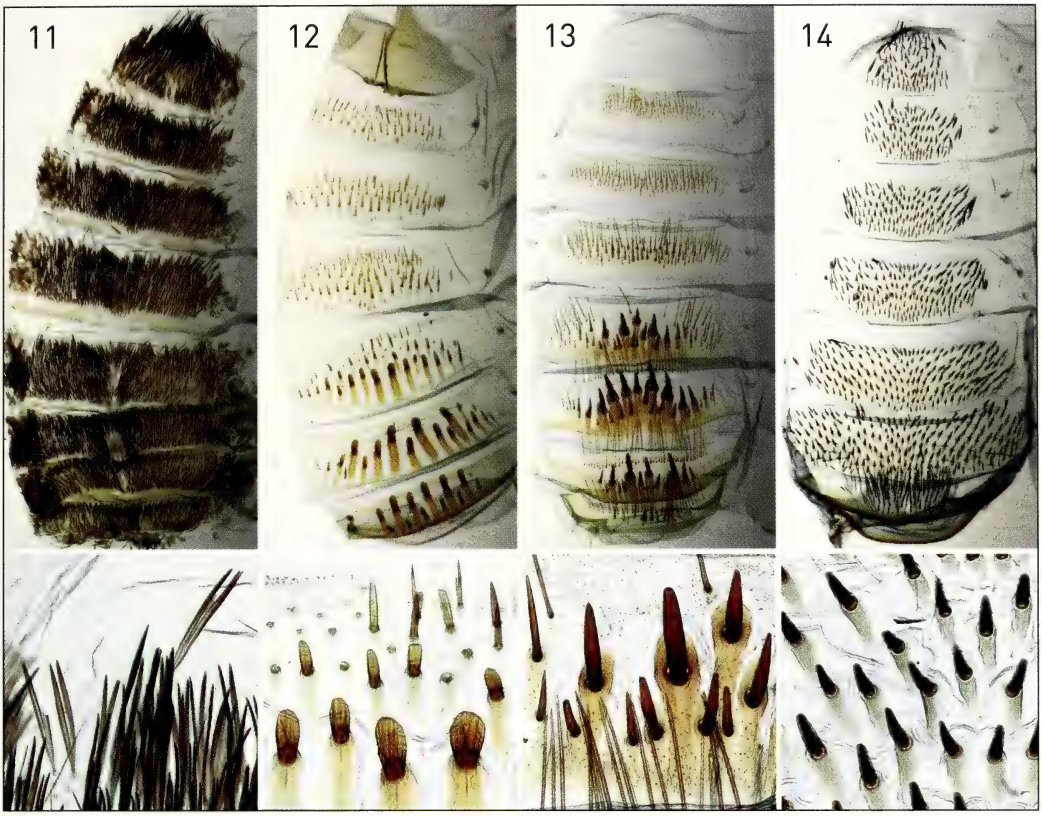


Fig. 10. Male abdominal tergites 1–5 of *Desertobia nocturna* Viidalepp, 1989 (after Viidalepp 1989).

genetic framework and absence of critical, modern generic revision of Boarmiini make the assessment of a more exact systematic position difficult. The Boarmiini relationship is supported by external habitus with several taxa, for instance *Chondrosoma fiduciaria* Anker, 1854 (Fig. 2), *Apocheima hispidaria* and several *Lycia* Hübner, [1825] 1816 species. The wing venation of *D. furcicornaria* is of characteristic Ennominae type, being essentially the same as in *Desertobia* Viidalepp, 1989 (see Viidalepp 1989) and *Chondrosoma fiduciaria* (our observation). The male genitalia of *D. furcicornaria* do not fit with any generic concepts of Boarmiini, but they are similar to *Apochima flabellaria* (Heeger, 1838) (Fig. 6), sharing with it for instance the asymmetric uncus, short, stout valvae, and the absence of gnathos (Figs 4–6). *A. flabellaria* does not have, however, any sclerotised structures in the abdominal tergites that are characteristic for *D. furcicornaria* (Fig. 14). The male genitalia of those taxa that have sclerotisations in the abdominal tergites (see Figs 10–14) are structurally different from that of *D. furcicornaria* sp. n. When a combination of several characters is evaluated, *D. furcicornaria*, *C. fiduciaria* and *A. flabellaria* appear morphologically the most similar (Figs 1–6). Viidalepp (1989) has applied the names Zamacrini and Apochimini to the genus *Apochima* Agassiz, 1847, but potentially these are introduced in a way that



Figs 11–14. Male abdominal tergites, with details enlarged (figures not to scale). **11.** *Lycia lapponaria* (Boisduval), Finland: Vähäkyrö, 26.iv.1946 (coll. ZMH, slide PS1361/Pasi Sihvonen). **12.** *Chondrosoma fiduciaria* Anker, Hungary: Budapest, 28.x.1945 (coll. ZMH, slide PS1390/Pasi Sihvonen). **13.** *Wilemania nitobei* (Nitobe), Japan: Bushi, Iruma, 24.xi.1973 (coll. BMNH, slide PS1867/Pasi Sihvonen). **14.** *Dorsispina furcicornaria* (coll. Nupponen, slide PS1877/Pasi Sihvonen).

does not fulfill the requirements of Article 13 of the International Code on Zoological Nomenclature (ICZN 2012; see also Beljaev 2008).

Abdominal tergites 3–8 of *D. furcicornaria* are densely covered with sclerotised spines (Fig. 14). We have not found similar structures elsewhere in the Palaearctic Ennominae, but various sclerotised structures on abdominal tergites are found in several Ennominae taxa (Figs 10–13). Unfortunately there is no phylogenetic framework available that would allow evaluating whether these structures are homoplastic or not. Tergites are densely covered with elongated scales in several *Lycia* (our observation) (Fig. 11) and *Biston* Leach, 1815 species (Boarmiini); in a few species in the latter these are partly developed to spines (Jiang et al. 2011). Wide, blunt-ending sclerotisations are found in *Chondrosoma fiduciaria* Anker, 1854 (Boarmiini), those are the most developed in tergites 2–4 (Fig. 12). In the East Palaearctic *Wilemania nitobei* (Nitobe, 1907) (Wilemanini), the sclerotisations are wide, with acute apex (Fig. 13). Those are structurally similar to the structures found in *Desertobia* Viidalepp, 1989 (Fig. 10), classified in the Desertobiini (Viidalepp 1989). According to Beljaev (2000), *Semidesertobia* Beljaev, 2000 is potentially related. The latter lacks abdominal sclerotisations,

but tergites are covered with numerous firm fork-like scales. Beljaev (2000) also proposed Desertobiini to be a junior synonym of Boarmiini. Further research is needed to clarify these relationships. The function of the abdominal sclerotisations is unknown.

The function of the peculiar thorax structure, the Y-shaped sclerotised extension, with smaller lateral extensions at the base (Fig. 7) in *D. furcicornaria* is also unknown. Potentially it may play a role in eclosion during the emergence of the imago from the pupal case. *Apochima flabellaria*, which might be related on the basis of the male genitalia structures, does not have dorsal sclerotisations on the thorax but it does have a small sclerotised, triangular structure on the dorsal margin of the frons.

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References

Beljaev, E. A. 2000. Remarkable new genus and species of the geometrid moths from Central Asia, related to the genus *Desertobia* Viidalepp, 1989 (Lepidoptera, Geometridae, Ennominae) with notes on the taxonomy of the Desertobiini. – Tinea **16**: 240–245.

Beljaev, E. A. 2008. Phylogenetic relationships of the family Geometridae and its subfamilies (Lepidoptera). Meetings in memory of N. A. Cholodkovsky **60**: 1–238. [In Russian with English summary].

Hardwick, D. F. 1950. Preparation of slide mounts of Lepidopterous genitalia. – Canadian Entomologist **82**: 231–235.

Holloway, J. D. 1994 (dated 1993). The moths of Borneo, part 11: Family Geometridae, Subfamily Ennominae. – Malayan Nature Journal **47**: 1–309.

ICZN (International Commission on Zoological Nomenclature) 2012. International code of Zoological Nomenclature, 4th ed. Available online at http://www.nhm.ac.uk/hosted-sites/iczn/code. Accessed 20 May 2013.

Jiang, N., D. Xue & H. Han 2011. A review of *Biston*, 1815 (Lepidoptera, Geometridae, Ennominae) from China, with description of one new species. – Zookeys **139**: 45–96.

Klots, A. B. 1970. Lepidoptera. Pp. 115–130. – *In*: S. L. Tuxen (ed.), Taxonomists' glossary of genitalia in insects. – Munksgaard, Copenhagen.

Kristensen, N. P. 2003. Skeleton and muscles: adults. Pp. 39–122. – *In*: N. P. Kristensen (ed.), Lepidoptera, Moths and Butterflies, Vol. 2: Morphology, Physiology, and Development. Handbook of Zoology, volume IV, Arthropoda: Insecta, part 36. – Walter de Gruyter, Berlin.

McGuffin, W. C. 1977. Guide to the Geometridae of Canada (Lepidoptera), II, Subfamily Ennominae 2. – Memoirs of the Entomological Society of Canada **101**: 1–191.

Mironov, V. G., E. A. Beljaev & S. V. Vasilenko 2008. Fam. Geometridae. Pp. 190–227. – *In*: S. Yu. Sinev (ed.), Catalogue of the Lepidoptera of Russia. – KMK Scientific Press, St. Petersburg, Moscow.

Parsons, M. S., M. J. Scoble, M. R. Honey, L. M. Pitkin & B. R. Pitkin 1999. The Catalogue. Pp. 1–1016. – *In*: M. J. Scoble (ed.), Geometrid Moths of the World: a Catalogue (Lepidoptera, Geometridae). – CSIRO Publishing, Collingwood.

Prout, L. B. 1912–1916. Die Spanner des Palaearktischen Faunengebietes. Pp. 1–479. – *In*: A. Seitz (ed.), Die Gross-Schmetterlinge der Erde, Vol. 4. – Verlag A. Kernen, Stuttgart.

Sihvonen, P., M. Mutanen, L. Kaila, G. Brehm, A. Hausmann & H. S. Staude 2011. Comprehensive molecular sampling yields a robust phylogeny for geometrid moths (Lepidoptera: Geometridae). – PLoS ONE **6** (6): e20356. doi:10.1371/journal.pone.0020356.

Viidalepp, J. 1989. A new genus and a new tribus of Geometrid moths (Lepidoptera, Geometridae: Desertobini, trib. n.). – Proceedings of the Zoological Institute, Leningrad **200**: 94–109. [In Russian].

Viidalepp, J. 1996. Checklist of the Geometridae (Lepidoptera) of the former U.S.S.R. – Apollo Books, Stenstrup. 111 pp.

Wehrli, E. 1939–1954. Die Spanner des Palaearktischen Faunengebietes. Pp. 254–766. – *In*: A. Seitz (ed.), Die Groß-Schmetterlinge der Erde, Vol. 4, Supplement. – Verlag A. Kernen, Stuttgart.

Zoological Record Plus 2013: An online database, available at http://search.proquest.com/zoological-record/index?accountid = 11365. Accessed 12 February 2013.

First record of *Cacyreus marshalli* Butler, 1898 (Lycaenidae) from Turkey

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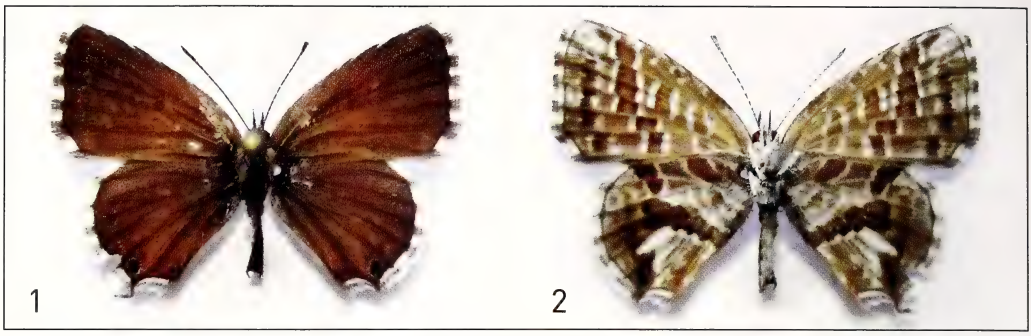
Cacyreus marshalli Butler, 1898, originally described from South Africa, was accidentally introduced into the Balearic archipelago through importation of its ornamental host plant (*Pelargonium*; Geraniaceae), and has been expanding its range in Europe and northern Africa since 1988 (Marko & Verovnik 2009; Tshikolovets 2011). The first records came from Mallorca (1988), Belgium (1991), mainland Spain (1992), Italy (1996) and Morocco (1997). The current range of the species in the Palaearctic region is given as Canary Islands, Madeira, Morocco, Iberian Peninsula, Balearic Islands, southern France, Corsica, Sardinia, Italy, Switzerland, Slovenia, Croatia, Malta, Greece, as well as single records of introduced individuals from southern England, the Netherlands, Belgium and Germany (Tshikolovets 2011). In Greece, the species was first found on Corfu in 2008 (Parker 2010), and a year later also in Attica (Athens & Spétses Island; Anastassiu et al. 2010; Coutsis et al. 2011; Martinou et al. 2011). Recorded host plants include *Geranium* and *Pelargonium* (Geraniaceae) (South Africa) as well as imported and cultivated *Pelargonium* in Europe (Eitschberger & Stamer 1990; Marko & Verovnik 2009).

Cacyreus marshalli had never before been recorded in Turkey. Our first observation of a specimen was in Gündoğan (Bordum district) in August 2011. Because no specimens were collected and photographed at that time, the region was surveyed again in 2012. On the 23rd of October 2012, we collected the first male specimen (Figs 1, 2) in Bodrum, Gündoğan (N 37° 8′ 56.48″, E 27° 20′ 9.55″; Fig. 3), nectaring on *Pelargonium.* The specimen is currently deposited in the research collection of the first author. A systematic investigation of the scale of larval damage to *Pelargonium* plants in the area remains to be done. This area is a touristic region in the southwest of Turkey near the Aegean Sea. The approximate location of our observation in Turkey is given in the distribution map (Fig. 3). Bodrum Peninsula is only about 15 km linear distance from the Greek Dodecanese island of Kalymnos, where *C. marshalli* was observed at several locations near Panormos in October 2011 (Kissling 2012). It is to be expected that this invasive species will spread further in the Eastern Mediterranean Region along the Turkish coast.



Figs 1, 2. *Cacyreus marshalli* specimen from Turkey **1.** Upper side. **2**. Underside.

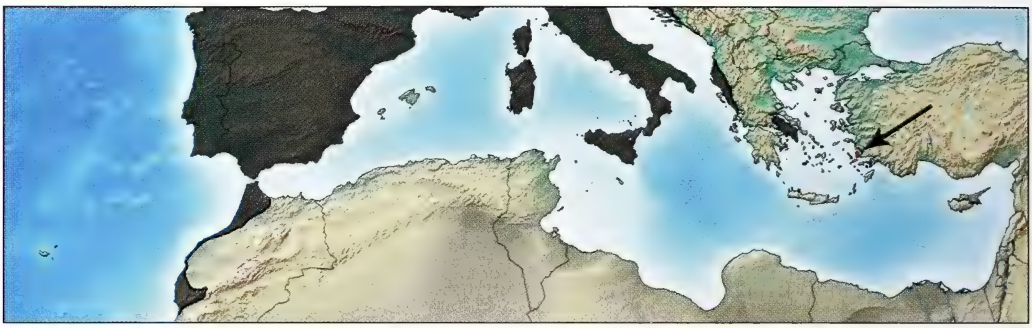


Fig. 3. Known distribution of *Cacyreus marshalli* in Europe and North Africa (shaded area; modified from Tshikolovets 2011), and the approximate position of the observation in Turkey (red circle, arrow).

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References

Anastassiu, H. T., N. Ghavalas & J. G. Coutsis 2010. First record of *Cacyreus marshalli* in Greece, and comments on the potential occurrence of *Zizeeria karsandra* on the Greek island of Crete (Lepidoptera: Lycaenidae). – Phegea **38** (3): 85–92.

Coutsis, J. G., H. T. Anastassíu & N. Ghavalas 2011. An explanatory note on a previous article of ours, population fluctuations of the imported *Cacyreus marshalli* in Greece, and an assessment of its being a potential threat through larval competition to native butterflies with Geranium feeding larvae (Lepidoptera: Lycaenidae). – Phegea **39** (2): 43–44.

Eitschberger, U. & P. Stamer 1990. *Cacyreus marshalli* Butler, 1898, eine neue Tagfalterart für die europäische Fauna? (Lepidoptera, Lycaenidae). – Atalanta **21** (1/2): 101–108.

Kissling, T. 2012. *Cacyreus marshalli.* – http://www.lepiforum.de/cgi-bin/2_forum.pl?md=read;id=84671. Accessed December 2012.

Marko, K. & R. Verovnik 2009. First record of *Cacyreus marshalli* (Lycaenidae) from the Balkan Peninsula. – Nota lepidopterologica **32** (1): 81–82.

Martinou, A. F., D. Papachristos & P. G. Milonas 2011. Report of the Geranium Bronze Butterfly, *Cacyreus marshalli* for mainland Greece. – Hellenic Plant Protection Journal **4**: 31–34.

Parker, R. 2010. *Cacyreus marshalli* Butler, 1898 (Lepidoptera, Lycaenidae) newly recorded for Corfu, with notes on other butterflies on the island in September 2008. – Entomologist's Gazette **61**: 40–42.

Tshikolovets, V. V. 2011. Butterflies of Europe and the Mediterranean Area. – Vadim Tshikolovets publications, 544 pp.

Remarks on Tortricidae species with unknown and little known females

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Abstract. The females of *Cnephasia heringi* Razowski, 1958 and *Gypsonoma obraztsovi* Amsel, 1959 are described and illustrated. Females of *C. daedalea* Razowski, 1983 are associated with males of *C. hellenica* Obraztsov, 1956, resulting in a new synonymy: *C. daedalea* syn. n. of *C. hellenica*. The formerly unknown female of *Dichrorampha rilana* Drenowsky, 1909 is described and illustrated.

Introduction

In Tortricidae, as in many other insect groups, the morphology of the male genitalia is well-studied and frequently used for taxonomic and phylogenetic purposes, whereas the female genitalia often are less characteristic, receiving relatively limited attention. The females of many species are rarely collected in comparison with their conspecific males, and in some species females are still unknown. Consequently, many tortricid species are either incompletely described or their alleged females actually belong to different species.

Field research in Bulgaria over the last few years has resulted in abundant material for various members of the family Tortricidae, including females of four species that were unknown or dubiously assigned to their male counterparts. The purpose of this paper is to describe and illustrate the females of these species and discuss the taxonomic and/or nomenclatural implications of these discoveries.

Methods

Moths were collected by netting and sweeping with an aerial net in afternoon and twilight and by light-trapping. Several types of lamps were used for collecting at light: MBFT 160 W, "actinic" tubes 8 W and 13 W, and "blacklight" tubes 8 W, all powered by batteries and/or a generator. The material was spread immediately following its collection, and abdomens subsequently were dissected in the laboratory following the standard procedure of Robinson (1976). The material is preserved in the author's collection, a part of the entomological collection of the Faculty of Biology, Sofia University.

Results

Cnephasia heringi Razowski, 1958 — Figs 1, 2, 11

Material. **Bulgaria**, Struma valley, Rupite area near Petrich, the volcanic hill of Kozhuh, 200 m, N 41°27′39″ E 23°15′24”, 1♂ 13.vi.2008, leg. B. Zlatkov & O. Sivilov (coll. B. Zlatkov); Pirin Mts, near Ilindentsi, 470–540 m, N 41°39′05–10″ E 23°14′43–47″, 1♀ 14.vi.2008, leg. B. Zlatkov & O. Sivilov (coll. B. Zlatkov); 1♀ 3.vi.2012; 4♂♂, 3♀♀ 13.vi.2012.

Razowski (1958, 1959) described and illustrated the female genitalia of *C. heringi*, but later reversed his opinion (Razowski 2002), assuming that the illustrated females probably were not conspecific with the male of *C. heringi*. Thus the female of this species was in need of further investigation. Material collected recently from southwestern Bulgaria provided resolution to this problem. Males collected on several occasions from different localities were initially associated with a synchronous and syntopic female, the genitalia of which demonstrated similarity with the female genitalia of *C. heringi* illustrated by Razowski (1958). A longer series of male and female specimens (all collected on the same date and locality in 2012) confirmed that these females are indeed conspecific with the males of *C. heringi*.

Females are larger (forewing length 8.0–9.2 mm, median 8.4; n = 5) than males (forewing length 6.6–8.3 mm, median 7.5; n = 5). In both sexes the shape and markings of the forewing are very similar, with some variation (Figs 1, 2). The female genitalia (Fig. 11) have relatively slender lateral arms of the sterigma and a very short sclerite at the ostium with longer lateral parts. The colliculum is rather long, with a narrower and asymmetrical anterior end, ca. 1/2 the length of the entire ductus bursae, separated from the sterigma by a membranous area. The ductus seminalis originates from the anterior half of the portion of ductus bursae located between the colliculum and the corpus bursae. The signum is narrow, ca. 3/4 the length of the corpus bursae.

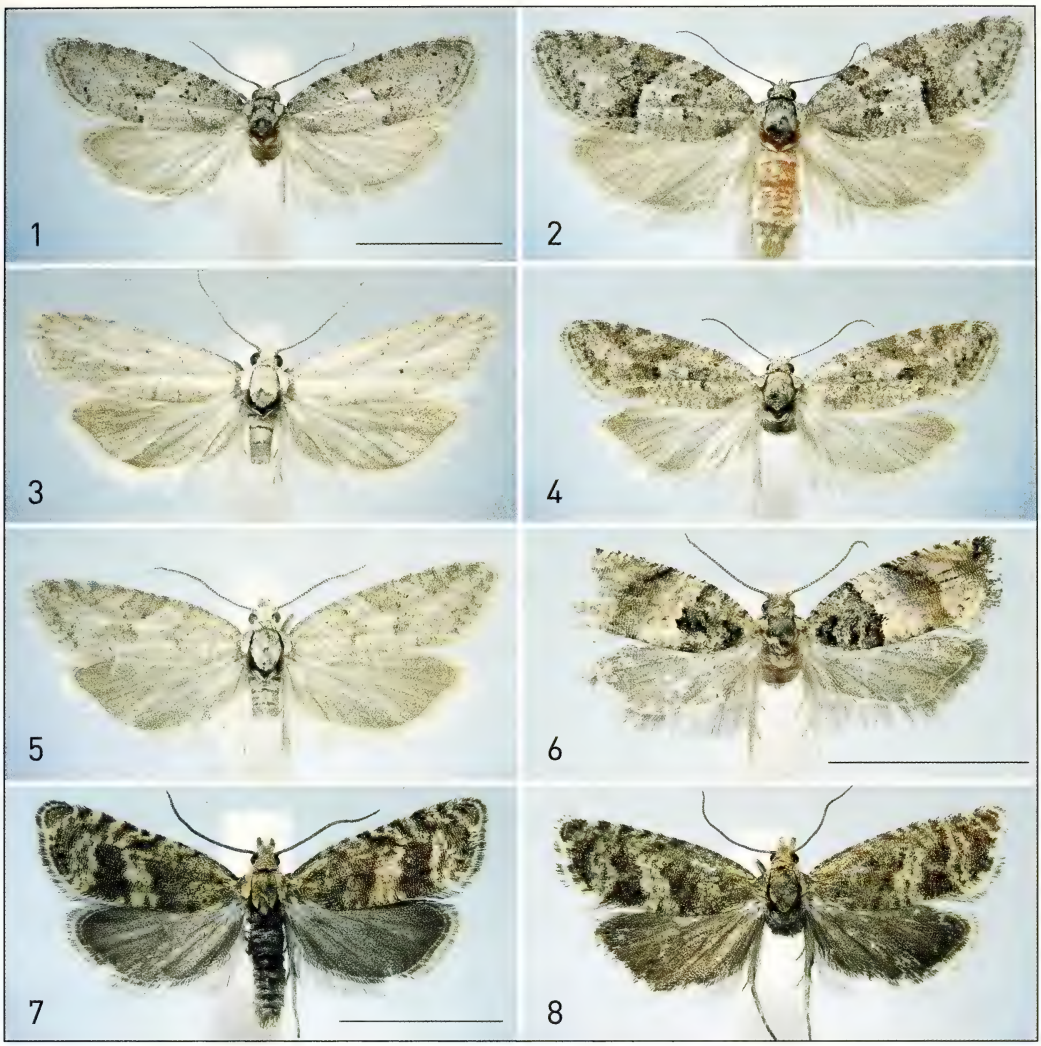
Habitat in Bulgaria: Dry, rocky areas up to 550 m a. s. l. in the southwestern part of the country.

Cnephasia hellenica Obraztsov, 1956 — Figs 3–5, 12

Cnephasia daedalea Razowski, 1983 **syn. n.**

Material. NE **Bulgaria**, Black Sea coast, Topola village near Balchik, 100 m, 1♀ 29–30.v.2010, leg. O. Karsholt (Zoological Museum of the University of Copenhagen); near Kaliakra Cape, Bolata place, 50 m, N 43°22′59″ E 28°28′03″, 7♂♂, 2♀♀ 24.v.2012, leg. B. Zlatkov & O. Sivilov (coll. B. Zlatkov).

C. helenica <sic> was described by Obraztsov (1950) from a single male collected in Greece. Obraztsov (1957) later emended the name to *hellenica*. The female was unknown until now. This species was reported recently from Bulgaria from males only (Beaumont 2011), which led me to search for females. In May 2012, I collected a long series of *Cnephasia* from a steppe habitat at the Northern Black Sea coast of Bulgaria. The characteristic male genitalia confirmed my supposition that they were *C. hellenica*, but among the series were two female specimens with the same wing pattern as male



Figs 1–8. Adults. **1, 2.** *Cnephasia heringi* Razowski, male (1) and female (2) (Bulgaria, Ilindentsi). **3–5.** *Cnephasia hellenica* Obraztsov, males (3, 5) and female (4) (Bulgaria, Kaliakra cape). **6.** *Gypsonoma obraztsovi* Amsel, female (Bulgaria, Primorsko). **7, 8.** *Dichrorampha rilana* Drenowsky, male (7) and female (8) (Bulgaria, Vitosha mountain). Figs 1–5 and 7–8 are proportional. Scale bar = 5 mm.

C. hellenica. However, the dissected female genitalia appeared identical with those of *C. daedalea* illustrated by Razowski (1983, 2002). *C. daedalea* was described from a single female from Sardinia (Razowski 1983), and no further localities were known until 2011. In fact Šumpich (2011) reported *C. daedalea* from Spain (as new to the Spanish fauna and first record for the European mainland) from two females and four males, and described the "unknown" male genitalia. It should be mentioned that *C. hellenica* was already known from Spain (Razowski 2002). However, the male genitalia illustrated by Šumpich (2011) are a perfect fit with those of *C. hellenica*. Based on these observations, I conclude that *hellenica* and *daedalea* are conspecific and that *C. daedalea* is a junior synonym of *C. hellenica*.

Figs 9, 10. Larval host plant and habitat of *Dichrorampha rilana* Drenowsky. **9.** *Achillea clusiana* Tausch (Bulgaria, Rila mountain, 5.vii.2012); inset: close-up of inflorescence (photograph by O. Sivilov). **10.** Habitat (Bulgaria, Rila mountain near Kalin summit, 2500 m a.s.l.) (photograph by O. Sivilov).

Females are smaller than males (forewing length 7.0–8.3 mm, median 7.6 mm; n = 3 in females and 7.4–8.5 mm, median 7.8 mm; n = 7 in males), with relatively narrower wings. Seemingly, they are rarely collected in comparison with the males. The wing markings are reduced in males, some specimens are nearly monochromous gray or whitish; in contrast, females have more distinct markings (Figs 3–5). Both the male and female genitalia are very characteristic; the male has a thorn-like process near the middle of the sacculus, and the colliculum of the female is wide, more or less reminiscent of a grape cluster (Fig. 12). The moths are active in late afternoon and at twilight and are also attracted to light.

Habitat in Bulgaria: Western Pontic steppes in the north-eastern part of the country near the sea coast where the very limited association *Paeonio tenuifoliae-Koelerietum brevis* (Tzonev et al. 2006) occurs.

Gypsonoma obraztsovi Amsel, 1959 — Figs 6, 13

Material. **Bulgaria**, Black Sea coast, Atanasovsko lake, 0 m, N 42° 34′43″ E 27° 29′39″, 1♀ 30.vii.2011, leg. S. Beshkov & M. Beshkova (coll. B. Zlatkov); near Primorsko, 0 m, N 42°17'00″ E 27° 44′42″, 1♀ 30.vi.2009, leg. B. Zlatkov & R. Bekchiev (coll. B. Zlatkov).

This species was described from Asia (Iran) and subsequently reported from several European countries. It is a rare species and the females are found on rare occasions. Razowski (2003) mentioned that the female is unknown, but the same author (Razowski 1966) provided a schematic illustration and a very short description of the female genitalia of a specimen collected in Syria. Here I provide a more detailed description and illustration of the female of *G. obraztsovi* based on two relatively well-preserved specimens.

The wing pattern of the female resembles that of the male (Fig. 6). Forewing length 5.0–5.2 mm (median 5.1; n = 2). In the female genitalia (Fig. 13) the genital plate has round edges and a shallow incision at the distal edge. The sterigma is more or less ellipsoid, with a sclerotized ring around the ostium bearing lobes on both sides. The ostial

sclerite is weak, consisting of two parts, and the colliculum is trapezoidal. The ductus bursae is moderate, with a very short membranous posterior part preceded by a comparatively long wrinkled cingulum and a membranous anterior part with approximately the same length of the cingulum. The corpus bursae has two equal, large, flat signa with rounded ends. The ductus seminalis is inserted dorsolaterally at the proximal end of the cingulum.

Habitat in Bulgaria: Wet areas with *Salix* and *Populus* (Salicaceae) at low altitude in the southern parts of the country.

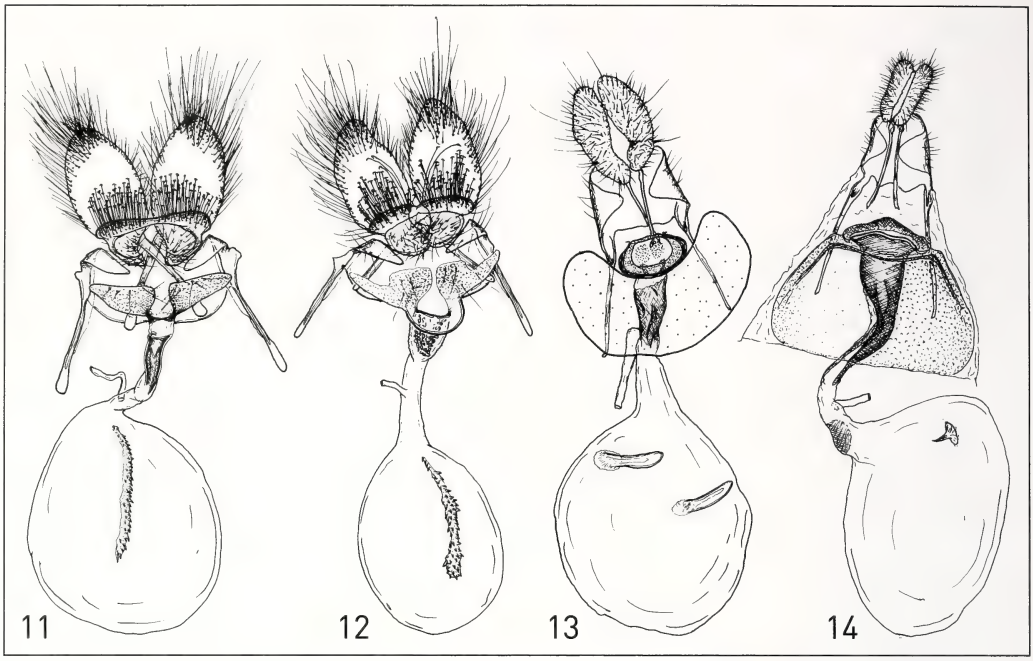
Dichrorampha rilana Drenowsky, 1909 — Figs 7–10, 14

Material. **Bulgaria**, Rila Mts, above Borovets resort, the path Yastrebets-Musala, 2300 m, N 42° 13′15″ E 23° 34′43″, 1♀ 5.vii.2012, leg. B. Zlatkov & O. Sivilov (coll. B. Zlatkov); near Kalin summit, 2500 m, N 42°10'56″ E 23°15'33″, 1♀ 7.vii.2012, leg. B. Zlatkov & O. Sivilov (coll. B. Zlatkov); Vitosha Mts, the path Aleko-Cherni vrah, 2100 m, N 42°34′23″ E 23°17′05″, 2♀ 13.vii.2012, leg. B. Zlatkov (coll. B. Zlatkov).

This species was poorly known and of questionable taxonomic status for a long time. A recent study based on male specimens revealed that it is distinct (Huemer et al. 2012); however, the females remained unknown. Field work in Bulgaria resulted in the discovery of the female and some data on the biology of *D. rilana*.

For a detailed description of the male see Huemer et al. (2012). Females are slightly smaller than males, with forewing length 6.1–6.5 mm (median 6.3; n = 4), but the wing pattern is identical with those of the males (Figs 7, 8). In the female genitalia (Fig. 14) the subgenital (antevaginal) plate is trapezoidal with rounded anterior angles and weakly concave posterior margin. The sterigma is sclerotized, with a large lip-like, medially incised, anterior lobe and a narrow arched posterior part. The ostium is very wide followed by a sclerotized infundibular part of ductus bursae; the sclerotization is asymmetrical, with longitudinal folds, and bent to the left. The proximal 1/3 of the ductus bursae is membranous, with the ductus seminalis inserted nearby the sclerotized area. The signum is short. The female genitalia are considerably different from those of two closely related species, *D. ligulana* (Herrich-Schäffer, 1851) and *D. dinarica* Huemer, Zlatkov & Baixeras, 2012, especially in the shape of the sterigma.

The larval host plant of *D. rilana* was unknown, although it was presumed to be *Achillea* (Asteraceae). The most common representative of this plant genus occurring in the subalpine habitats of the moth in Rila mountains is *A. clusiana* Tausch (Fig. 9), which proved to be the food plant. Numerous individuals were collected by sweeping *A. clusiana* in the daytime. Other *Achillea* spp. were also searched for *D. rilana* without positive results, so the species is likely to be monophagous. The discovery of the food plant allowed targeted investigation for this species in two neighbouring mountain massifs: Pirin (the northern part) and Vitosha, and it was found in both. It should be emphasized that *A. clusiana* occurs only on siliceous soils and never on carbonate; correspondingly, *D. rilana* was found only on silicates. It is probable that the distributional range of this species is limited by the rock composition of the high mountain massifs – the middle and southern parts of Pirin consist of limestone, and *D. rilana* was not found there.



Figs 11–14. Female genitalia. **11**. *Cnephasia heringi* Razowski; **12**. *Cnephasia hellenica* Obraztsov; **13**. *Gypsonoma obraztsovi* Amsel; **14**. *Dichrorampha rilana* Drenowsky.

D. rilana does not appear to be a rare species at altitudes of 1800–2600 m, but it is closely associated with its food plant. The former impression of rarity arose from some behavioural features of the species. As a rule, the moths are not very active and fly occasionally for very short distance in late afternoon. Numerous flying individuals (males) were observed only once, just before sunset and under perfect weather conditions (calm weather and temperature about 18°C), which is rare at high altitudes in the highest Bulgarian mountains. Females were collected much more rarely than males (total of 26♂, 4♀). The species is now known from the Vitosha, Rila and Pirin mountains.

Habitat (Fig. 10): Subalpine herbaceous formations on siliceous soils, sometimes mixed with *Pinus mugo* Turra (Pinaceae), at altitude 1800–2600 m, with *Achillea clusiana*.

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References

Beaumont, H. E. 2011. *Cnephasia hellenica* Obraztsov, 1956 (Lep. Tortricidae: Tortricinae): an addition to the Bulgarian fauna. – The Entomologist's Record and Journal of Variation **123**: 90.

Huemer, P., B. Zlatkov & J. Baixeras 2012. *Dichrorampha dinarica*, new species, a century of confusion in European lepidopterology (Lepidoptera: Tortricidae) resolved by combining morphology and DNA barcoding. – Zootaxa **3389**: 41–50. http://www.mapress.com/zootaxa/2012/f/z03389p050f.pdf

Obraztsov, N. S. 1950. Neue und wenig bekannte mediterrane Tortriciden-Arten (Lep., Tortr.). – Eos **26** (3–4): 299–319.

Obraztsov, N. S. 1957. Die Gattungen der palaearktischen Tortricidae. I. Allgemeine Aufteilung der Familie und die Unterfamilien Tortricinae und Sparganothinae. 3. Fortsetzung und Schluss. – Tijdschrift voor entomologie **100** (3): 309–347.

Razowski, J. 1958. New and little known Palaearctic species of the genus <sic> Cnephasiini (Lepidoptera, Tortricidae). – Acta zoologica cracoviensia **2** (25): 560–606.

Razowski, J. 1959. European species of Cnephasiini (Lepidoptera, Tortricidae). – Acta zoologica cracoviensia **10** (3): 179–423.

Razowski, J. 1966. Ergebnisse einer österreichischen lepidopterologischen Sammelreise nach Syrien und dem Libanon. Teil IV.: Tortricoidea. – Zeitschrift der Wiener Entomologischen Gesellschaft **51**: 72–79.

Razowski, J. 1983. Descriptions of new *Cnephasia* Curtis (Tortricidae). – Nota lepidopterologica **6** (4): 235–238.

Razowski, J. 2002. Tortricidae of Europe. Vol. 1. Tortricinae and Chlidanothinae. – Slamka, Bratislava. 247 pp.

Razowski, J. 2003. Tortricidae of Europe. Vol. 2. Olethreutinae. – Slamka, Bratislava. 301 pp.

Robinson, G. S. 1976. The preparation of slides of Lepidoptera genitalia with special reference to the Microlepidoptera. – Entomologist's Gazette **27**: 127–132.

Šumpich, J. 2011. Faunistic data of several significant tortricid species from Spain with descriptions of four new species (Lepidoptera: Tortricidae). – Shilap **39** (154): 141–153.

Tzonev, R., V. Roussakova & M. Dimitrov 2006. The Western-Pontic steppe vegetation in Bulgaria. – Hacquetia **5** (1): 5–23.

Marek Bąkowski 2013. The Sesiidae (Lepidoptera) of Poland. Kontekst, Poznan, 277 pp. incl. 109 plates (70 in colour). Hard cover, format B5, ISBN 978-83-62564-36-1. Price: 40 EUR + 7 EUR for postage in Europe[1].

This book brings a complex revision of the clearwing moths (Sesiidae) of Poland. It is a comprehensive treatment of this family for the territory of Poland which comprises 31 species (of the about 110 species known in Europe). The text is supplemented by 36 text figures and 109 plates of adults and preadult stages. The general contribution of the work and its relevant results are clearly summarised in the abstract.

In the Introduction, the author briefly characterises the family Sesiidae, the level of our knowledge and the history of research. Methods of preparation and treatment of all developmental stages and individual morphological structures, the way of preparing images and genetic analyses are clearly described in the Material and Methods. A detailed description of adult morphology follows – attention is paid also to the morphological structures and body parts which are usually not used in diagnoses or taxonomy in other groups of Lepidoptera, e.g., colouring of the ventral and lateral parts of thorax and abdomen, and of the legs. The description of the adult includes genitalia characters of both sexes. The author also pays attention to the description of preadult stages – egg, larva and pupa, including chaetotaxy. In the chapter on Biology, the author primarily reviews the characteristic Batesian mimicry of clearwing species which manifests itself by the wing and body morphology, colouring and ways of moving. He further describes ways of oviposition, larval development and ethological manifestations of adults.

The biology of species is in close relation to their economic importance in several cases. In this regard, *Pennisetia hylaeiformis*, *Synanthedon tipuliformis* and *S. myopaeformis* are especially important in Poland; the author also mentions the possible harmfulness of *Synanthedon vespiformis* to fruit trees, *Paranthrene tabaniformis* and *Sesia apiformis* to poplar plantations and *Synanthedon formicaeformis* to osiers. The chapter on the pest species also contains possible ways for their control.

In the chapter on Distribution, the author discusses the different possible ways species spread from various glacial refugia after the last ice age, and he evaluates relations between distributional range size, trophic mode, and the zoogeographic origin. The excellent chapter on the systematics and phylogeny recapitulates historical development and changes of opinions on the position of the family Sesiidae within Lepidoptera, its relationship to other families and superfamilies and the intrafamilial division. The general introductory chapters of the monograph are concluded by the list of Polish species, keys to the subfamilies and genera based on external characters of adults and genitalia, keys to the genera based on pupae and keys to the genera and species based on larvae.

A substantial part of the book takes a systematic overview of species recorded in the territory of Poland. Morphological characteristics of adults, including male and female genitalia, larvae and pupae are given for individual genera and species; further biology, pheromone behaviour, habitat, distribution, and known records in Poland are summarised under each species. Keys to the species based on adults and pupae are supplied for individual genera. The new aspects taken into account in the book include especially the descriptions of preimaginal stages, in particular the morphology and chaetotaxy of larvae. The work is completed by a very comprehensive and representative overview of the literature which includes a complete Polish sesidological bibliography and all important foreign works. Particular attention was paid to the perfect text figures and especially to the set of plates with figures of adults, genitalia, pupae, larvae and SEM photos of morphological details (eggs, some structures of larvae, antennae and genitalia), all in high quality.

The publication is an example of a perfectly prepared monograph which is not only a precise summary of the published data, but it is mainly based on the author's 20 years of research. It provides new knowledge concerning the morphology of adults and preadult stages and the phylogeny, biology and distribution of clearwing species. Thus the work constitutes an important source of information for further studies of this family in Poland and elsewhere in Europe.

Zdeněk Laštůvka

[1] A limited number of copies is available from the author (bakowski@amu.edu.pl).

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